City of San Diego Climate Mitigation and Adaptation Plan
Summary of Mitigation and Adaptation Options

December 2011

The Climate Mitigation and Adaptation Plan (CMAP) is a companion document to the City's General Plan and aims to advance the goals for a more sustainable city. Specifically, it will:

- quantify the level of greenhouse gas emissions (GHG) from the community and City operations;
- establish reduction targets for 2020 and 2035;
- identify measures to reduce GHG levels;
- track and report progress each year; and
- be modified as needed to reach reduction targets.

Most of the measures taken to reduce GHG not only mitigate climate change but also contribute to the City's current and future prosperity. In many cases, GHG reduction is linked to energy and water conservation, green job creation, and leadership in the clean technology sector. Additionally, the CMAP will streamline San Diego's development review process for California Environmental Quality Act (CEQA) requirements. Although hard to quantify in monetary terms, the CMAP demonstrates to investors, businesses and residents that San Diego is committed to taking on the challenge of a changing climate as we make plans for the future.

State mandates provide a GHG reduction target of 1990 levels by 2020, which translates to about 15% below 2008 GHG levels. By 2050, the State target is 80% below 2020.

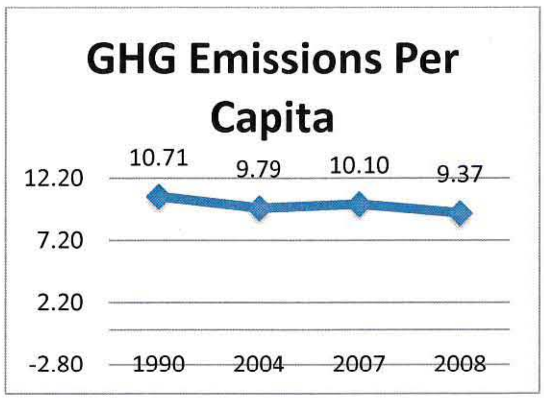
What is the roadmap for San Diego? The 2020 target is challenging but achievable because of current State and Federal mandates combined with progressive regional and local actions. However, as *Section One* will illustrate, the trajectory for achieving the 2050 goal is not possible with local actions alone. State and Federal laws and regulations would have to be significantly modified. Much higher participation rates in local programs would also be needed.

The current gap between what is achievable in 2035 through proposed measures and what may be required to get San Diego back on the trajectory to the 2050 target is the subject of this document. *Section Two* highlights the various local, State and Federal actions and associated GHG reduction.

Section Three is an explanation of the vulnerabilities for the San Diego region associated with a changing climate. It highlights steps to address those vulnerabilities keeping in mind that the ultimate goal is a more resilient community.

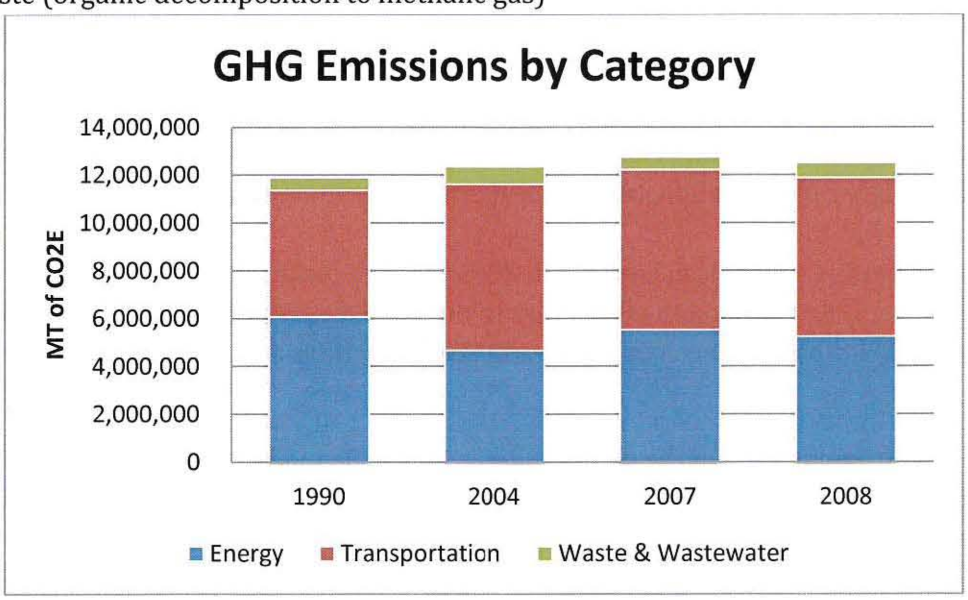
SECTION ONE: Where Are We Now?

In the City of San Diego, each person contributes an average of nine (9) metric tons per year of greenhouse gas emissions. Why? It is primarily because of transportation choices as well as heating and cooling decisions in buildings. The amount of waste we create and throw away is also part of the equation. The trend line for GHG per capita is going down, but not because we have changed our behavior. Cleaner fuels and more fuel-efficient vehicles make transportation less polluting, and the electricity we use is generated from cleaner sources. However, population increase offsets gains we make on an individual basis, and it is difficult to achieve significant reductions in the total GHG emissions. Nearly 1.4 million people live in San Diego, and each person has opportunities every day to use less fuel, conserve water and energy, waste less, and at the same time, reduce GHG.

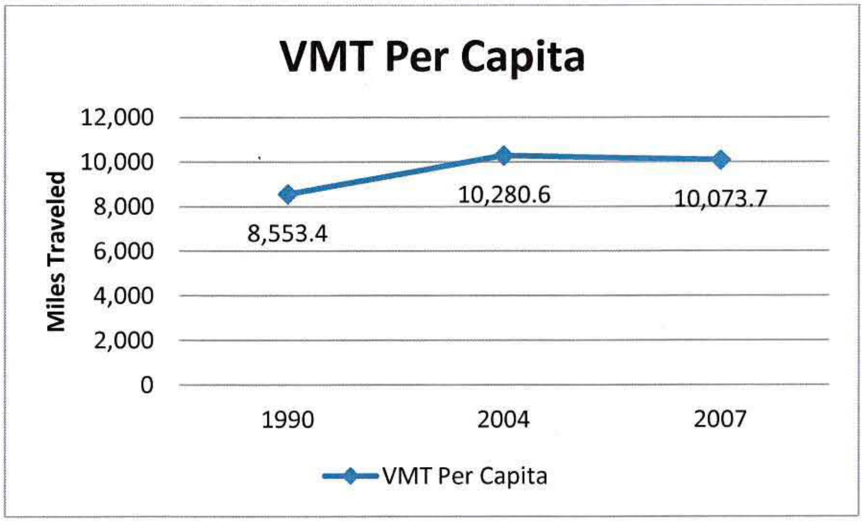


What are the causes of greenhouse gas emissions? There are three primary categories:

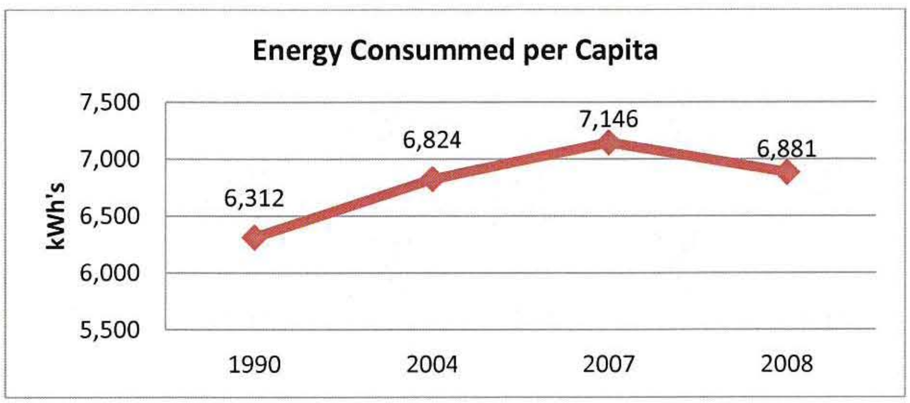
1. Energy (electricity and natural gas)
2. Transportation (fuel)
3. Waste (organic decomposition to methane gas)



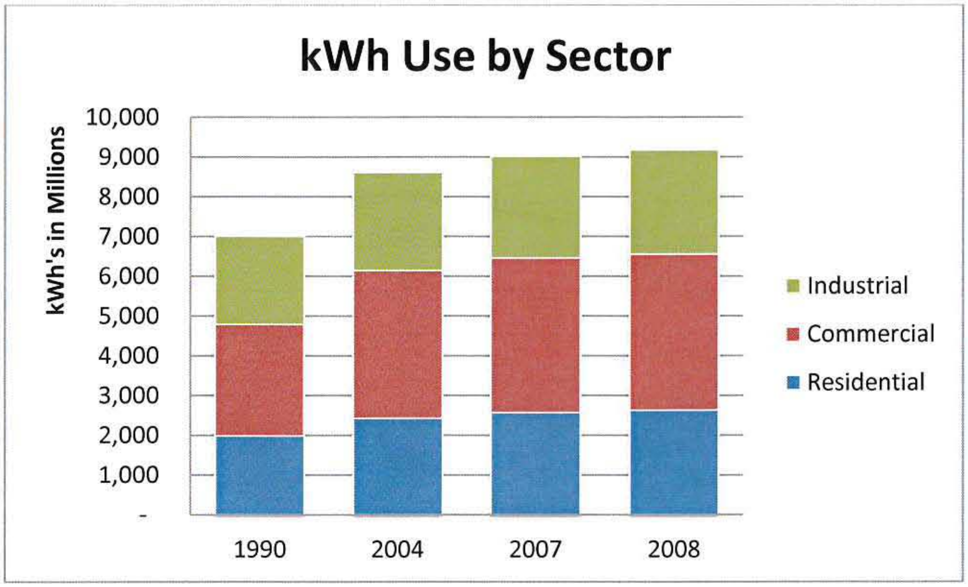
Since transportation is the leading cause of GHG in San Diego, the trend in "vehicle miles traveled" (VMT) is noteworthy. The chart, below, illustrates that on average we are travelling more per year in 2007 than we did in 1990. Additionally, there are more of us travelling.



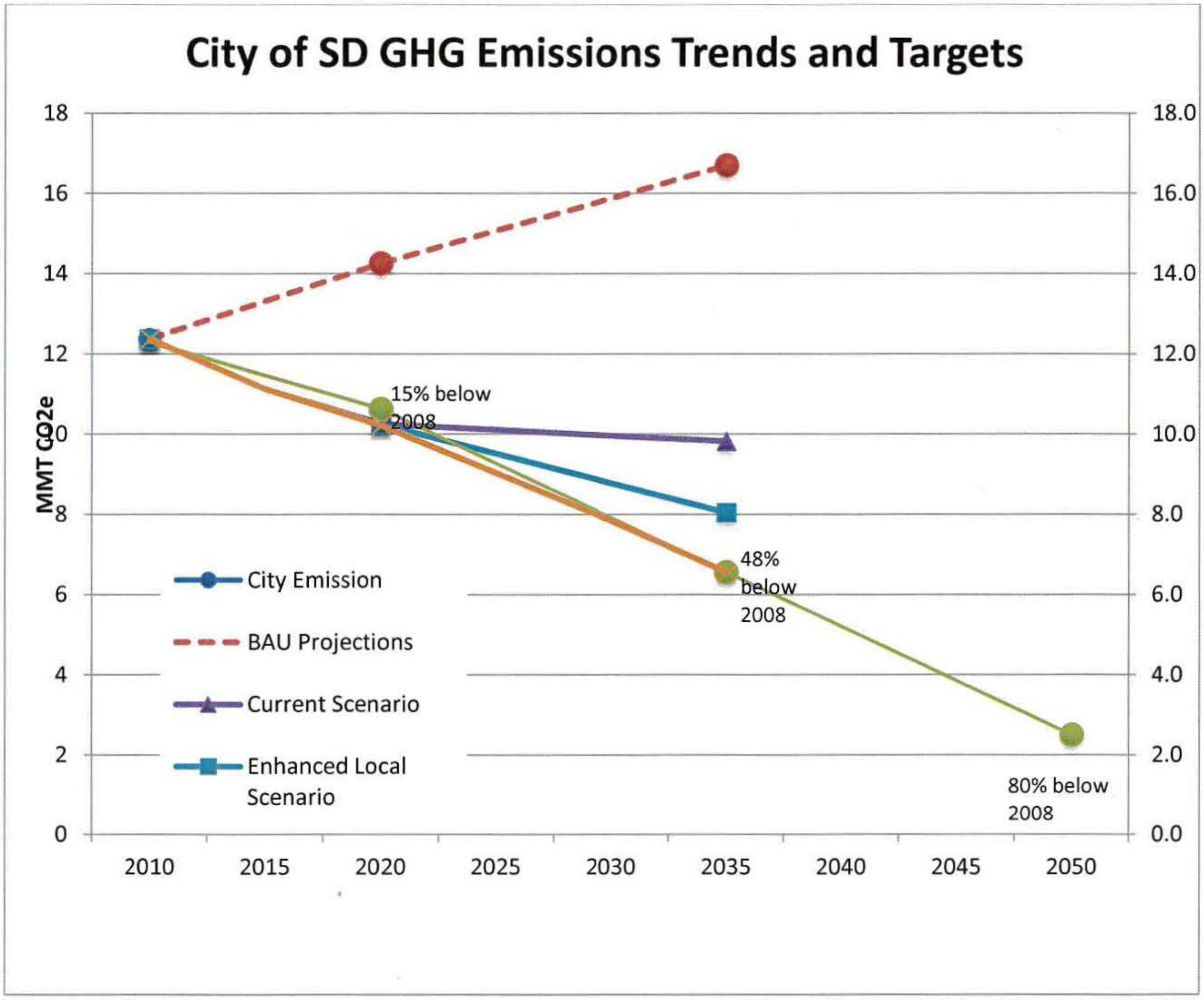
The TOTAL electricity consumed by the community includes residential, commercial and industrial. Dividing that total by the population equates to an average per capita usage. This indicator illustrates an upward trend in electricity use between 1990 and 2008.



The chart below shows the portion of electricity use by three sectors: residential, commercial and industrial. This is useful to compare and contrast kWh usage over time.



The graph on page 5 shows the *Business As Usual* (BAU) scenario. The BAU assumes that nothing different is done, based on 2008 data, and the population increases as expected. The *Current Scenario* is explained more in *SECTION TWO*. As shown, this path will reduce GHG to the required levels by 2020. However, due to population growth, there are no additional reductions of GHG through 2035. The *Enhanced Scenario* brings reductions to about 32 percent below 2008, which is an improvement, but still not on the trajectory to achieve the 2050 target.


City of SD GHG Emissions Trends and Targets
MMT CO2e
15% below 2008
48% below 2008
80% below 2008
City Emission
BAU Projections
Current Scenario
Enhanced Local Scenario
18
16
14
12
10
8
6
4
2
0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
2010
2015
2020
2025
2030
2035
2040
2045
2050

SECTION TWO: What Can We Do?

The priority of this report is to present options for reducing GHG in the City of San Diego. Three sets of options are presented: 1) Current Scenario; 2) Enhanced Local Scenario; and 3) Achieve 2035 Scenario (Local, State and Federal actions). The primary difference between Scenario 1 and 2 is the participation rate in various local programs. Scenario 3 characterizes the State and Federal assistance needed.

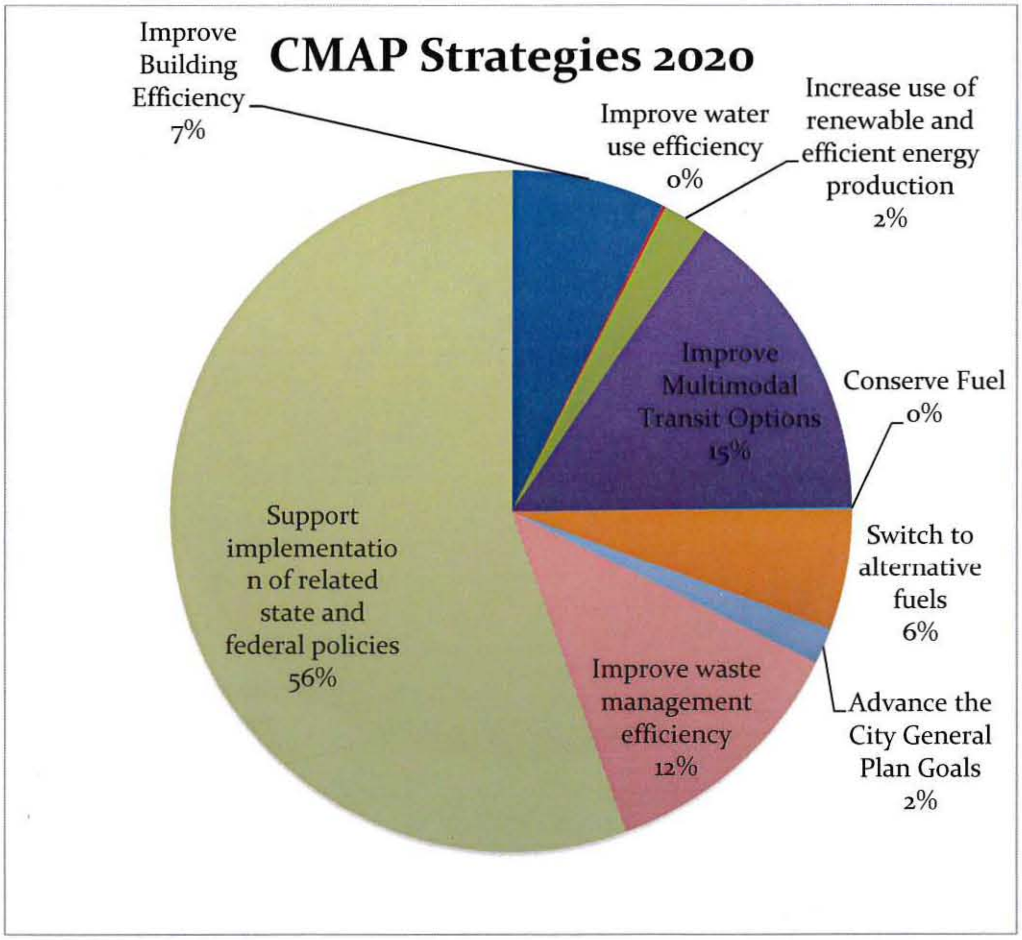
APPENDIX ONE is the list of mitigation measures for the Current Scenario. The most significant reductions will occur from State and Federal mandates that are currently in place. However, the State and Federal alone is not enough to reach the 2020 and 2035 targets. Local actions need to be in place achieve the 2020 target and must be maintained just to offset emission gains from population. For this reason, APPENDIX ONE also highlights the differences in participation rates and other factors that result in the GHG reductions for Scenario 2 and 3. This comparison illuminates the fact that much can be accomplished with local action. It also highlights opportunities at the State and Federal level.

APPENDIX TWO is a summary of a cost analysis done for many of the measures. The economic valuation of investments today that have future benefits is always challenging. To put it simply, it can be compared to making a commitment to spend money for routine oil changes on a car or ignoring that and damaging the engine. On the one hand, there are smaller incremental costs; on the other, there is averted cost for an unknown amount of time, and then a potentially huge expense.

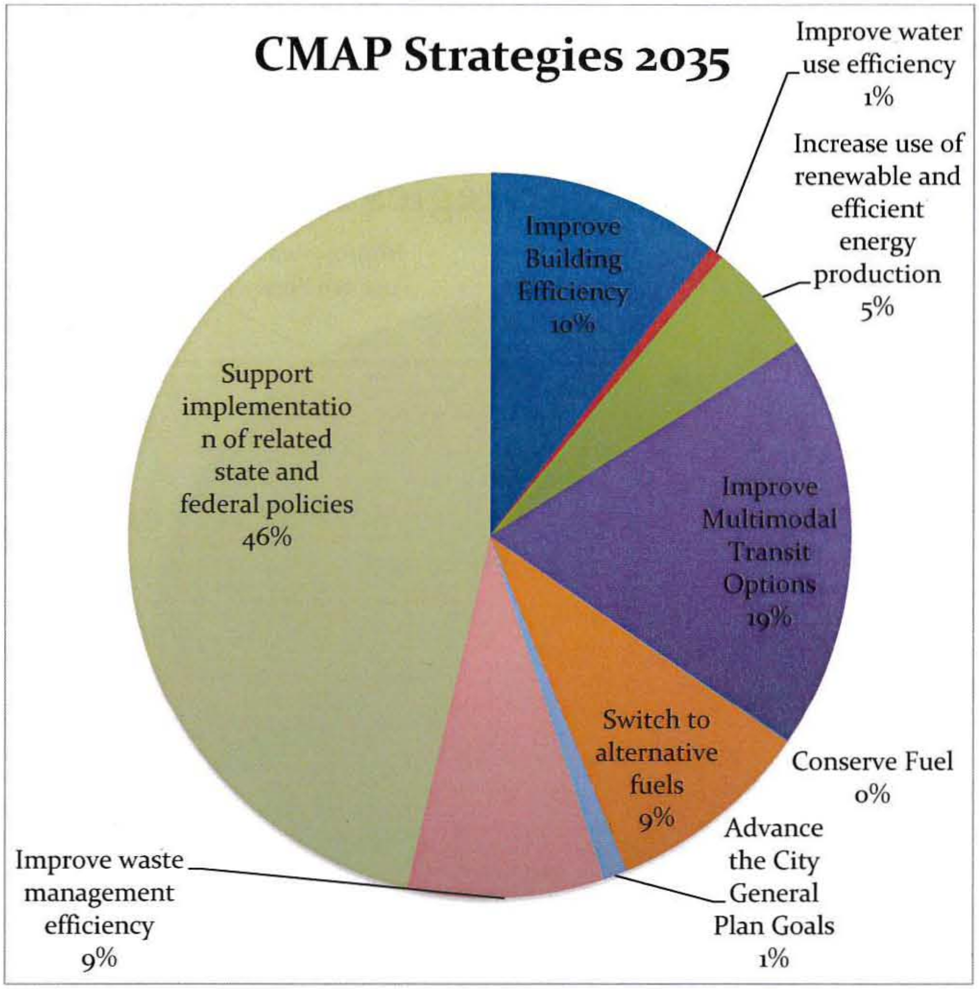
APPENDIX THREE is a summary of the Adaptation needs for the region. This is designed to start a discussion the steps needed for San Diego to be sustainable in changing climate.

APPENDIX FOUR is the Inventory and Projection Methods. This documentation clarifies how the various projections and assumptions were made.

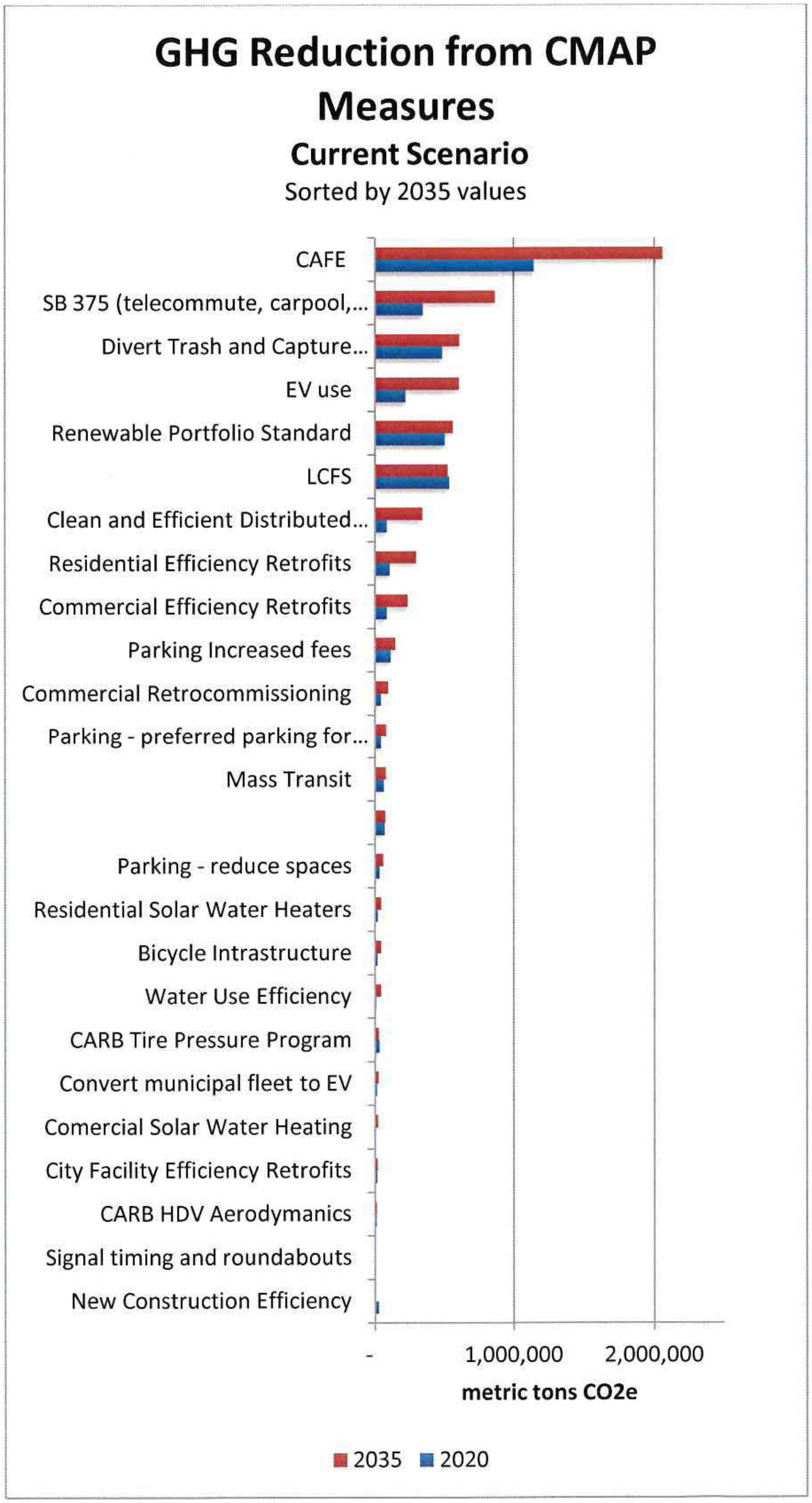
The following pie chart provides the categories identified to reach the 2020 Target. It is important to compare this pie chart with the one that follows indicating the 2035 reductions. The length of time the measure is in place can make a difference in the overall GHG impact. Included in the measures are State and Federal policies, laws and regulations that are adopted as of 2011. It would be the role of local government to support the implementation of these actions.

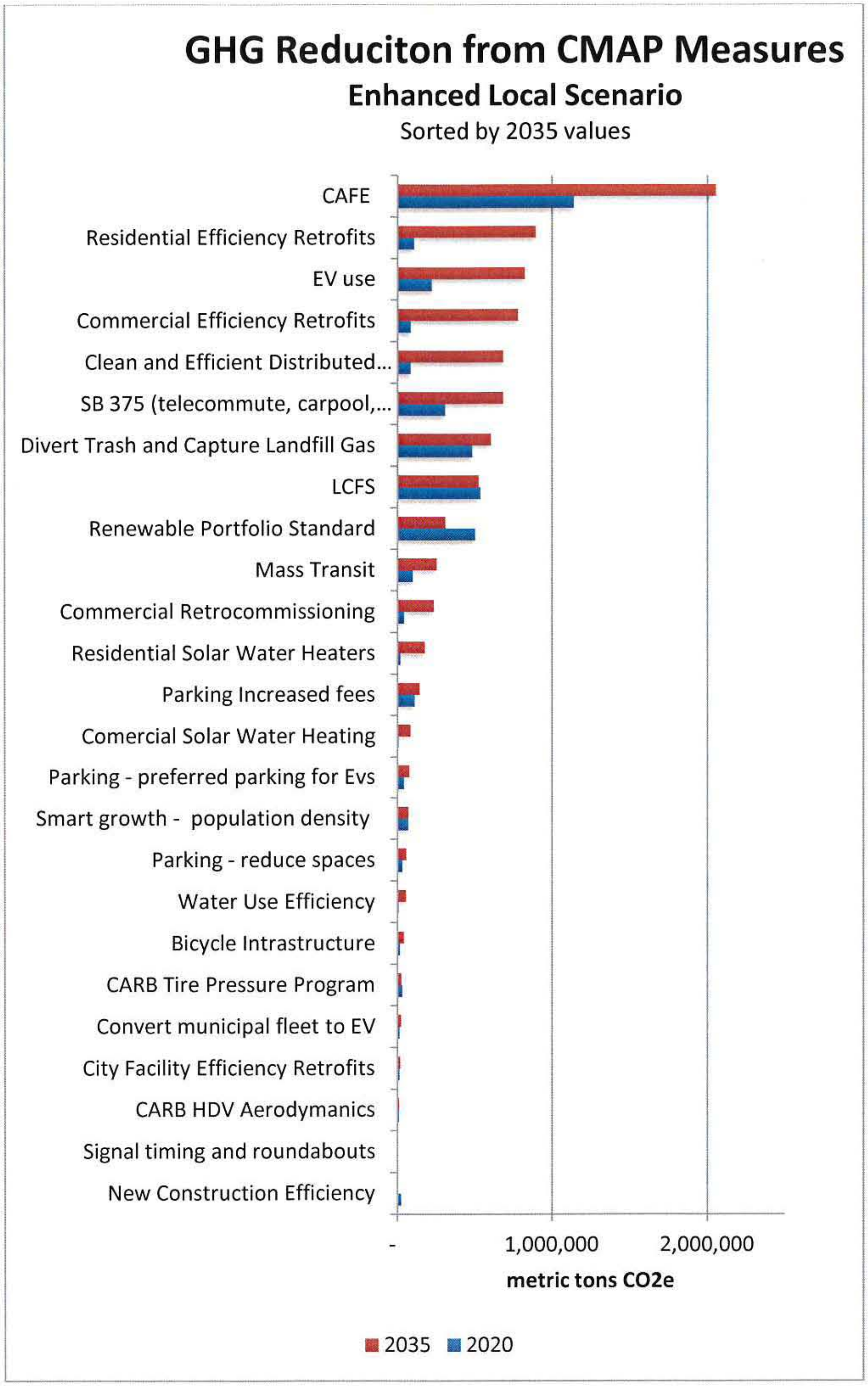


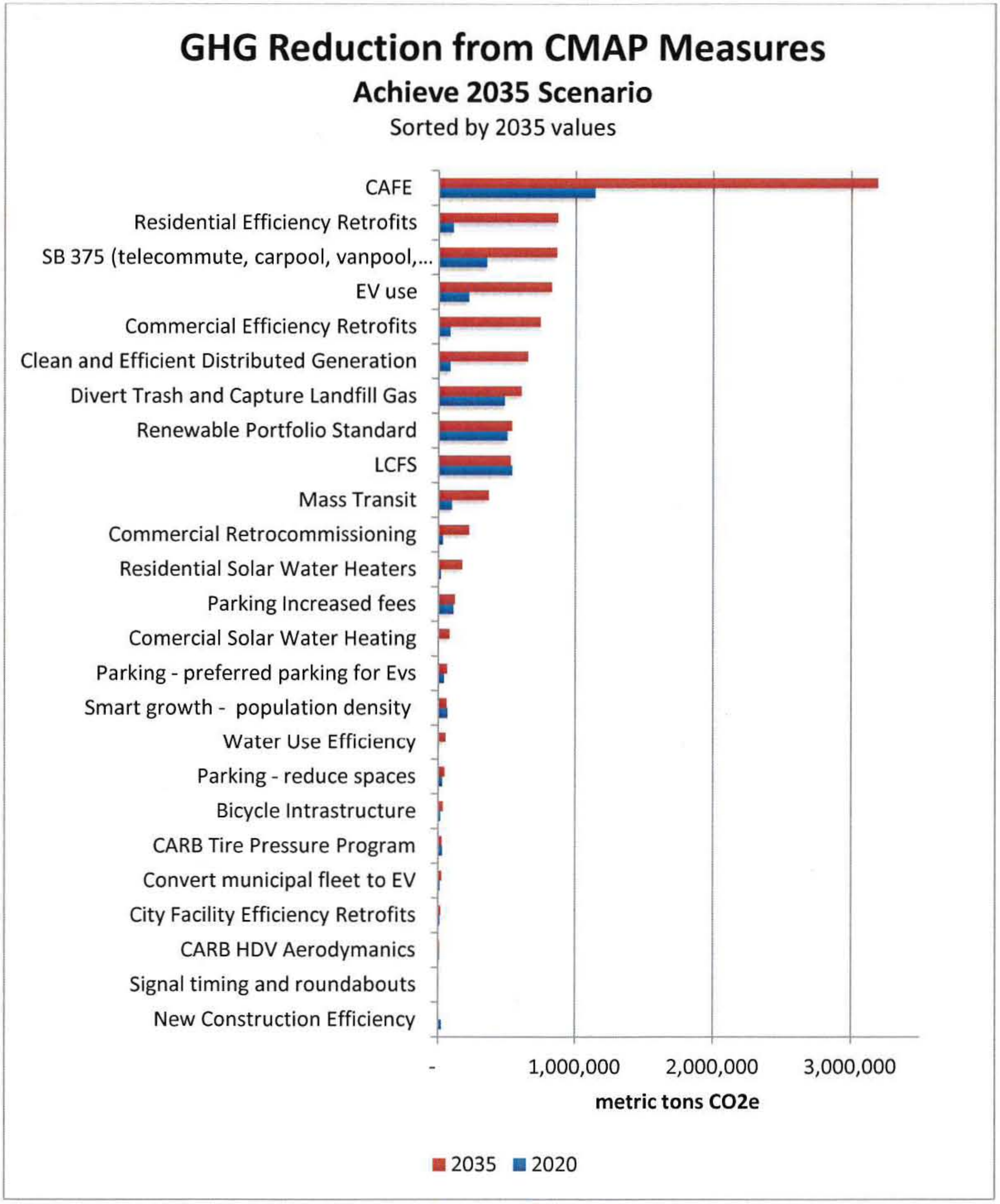
The categories of measures that are responsible for the 2035 reductions are indicated below.



The bar charts on the following three pages are useful in comparing the actual reductions gained from various measures. This view only pertains to GHG reductions. There are many other lenses by which to see the value of various actions. Therefore, some of the measures that appear to have low GHG reduction potential are important for other reasons. Three scenarios are presented, 1) Current Scenario; 2) Enhanced Local Scenario; and 3) Achieve 2035 Scenario (Local, State and Federal actions).


GHG Reduction from CMAP Measures
Current Scenario
Sorted by 2035 values
CAFE
SB 375 (telecommute, carpool,...
Divert Trash and Capture...
EV use
Renewable Portfolio Standard
LCFS
Clean and Efficient Distributed...
Residential Efficiency Retrofits
Commercial Efficiency Retrofits
Parking Increased fees
Commercial Retrocommissioning
Parking - preferred parking for...
Mass Transit
Parking - reduce spaces
Residential Solar Water Heaters
Bicycle Intrastructure
Water Use Efficiency
CARB Tire Pressure Program
Convert municipal fleet to EV
Comercial Solar Water Heating
City Facility Efficiency Retrofits
CARB HDV Aerodymanics
Signal timing and roundabouts
New Construction Efficiency
-
1,000,000
2,000,000
metric tons CO2e
2035
2020


GHG Reduciton from CMAP Measures
Enhanced Local Scenario
Sorted by 2035 values
CAFE
Residential Efficiency Retrofits
EV use
Commercial Efficiency Retrofits
Clean and Efficient Distributed...
SB 375 (telecommute, carpool,...
Divert Trash and Capture Landfill Gas
LCFS
Renewable Portfolio Standard
Mass Transit
Commercial Retrocommissioning
Residential Solar Water Heaters
Parking Increased fees
Comercial Solar Water Heating
Parking - preferred parking for Evs
Smart growth - population density
Parking - reduce spaces
Water Use Efficiency
Bicycle Intrastructure
CARB Tire Pressure Program
Convert municipal fleet to EV
City Facility Efficiency Retrofits
CARB HDV Aerodymanics
Signal timing and roundabouts
New Construction Efficiency
-
1,000,000
2,000,000
metric tons CO2e
2035
2020


GHG Reduction from CMAP Measures
Achieve 2035 Scenario
Sorted by 2035 values
CAFE
Residential Efficiency Retrofits
SB 375 (telecommute, carpool, vanpool,...
EV use
Commercial Efficiency Retrofits
Clean and Efficient Distributed Generation
Divert Trash and Capture Landfill Gas
Renewable Portfolio Standard
LCFS
Mass Transit
Commercial Retrocommissioning
Residential Solar Water Heaters
Parking Increased fees
Comercial Solar Water Heating
Parking - preferred parking for Evs
Smart growth - population density
Water Use Efficiency
Parking - reduce spaces
Bicycle Intrastructure
CARB Tire Pressure Program
Convert municipal fleet to EV
City Facility Efficiency Retrofits
CARB HDV Aerodymanics
Signal timing and roundabouts
New Construction Efficiency
-
1,000,000
2,000,000
3,000,000
metric tons CO2e
2035
2020

SECTION THREE: ADAPTATION?

Climate change presents numerous risks for cities around the world ranging in type, timing and severity. A recent assessment of climate change impacts for the San Diego region identified exacerbated conditions for heat waves, drought, wildfires, intense rainfall events and coastal inundation due to storm surge and sea level rise as of concern by and before 2050 (San Diego Foundation 2007). This regional study provides a valuable beginning in assessing the City of San Diego's specific vulnerability to these climate change impacts and the development of an appropriate response to limit the consequences for the city and community.

Previous San Diego climate action plans (2004) have focused primarily on the mitigation of climate change; that is the reduction of greenhouse gases now at unprecedented levels in our atmosphere. While reducing greenhouse gases is important, even with significant emissions reductions some level of climate change impacts is now inevitable and therefore must be considered and addressed. This is the first focused endeavor by the City of San Diego to initiate a program to respond to the vulnerabilities of the region through adaptation measures.

Adaptation strategies are largely based on preparedness for and/or protection from the risks projected to occur over time. Good adaptation stems from a solid understanding of the region's specific risks, now and in the future, and taking effective and timely action to alleviate the range of consequences. Risks can be addressed by reducing vulnerability or exposure. This can be accomplished by increasing infrastructure resilience, transferring the risk through insurance, negating the risk through technological change or retreat, or through behavior change programs and revised protocols.

As not all issues can or should be addressed at once, it is important that risks be prioritized to maximize the use of the City's resources while ensuring a timely and effective response. The most important consideration is public health and safety, closely followed by essential services, liveability, prosperity and even liability. Risks that present the most serious consequences and are projected to occur first are the highest priority to address; however, it is also important to initiate responses to serious longer-term risks if their response requires substantial time to implement.

Through this CMAP process, the City has increased its understanding of the implications of climate change impacts and is building the base of knowledge in the community to ensure all future decisions consider these impacts and do not create further vulnerabilities or liabilities. As this is the beginning of the City's foray into developing its adaptation response, many early initiatives are exploratory in nature and aim to identify appropriate changes or actions to respond to the impacts of concern. Reviews of current Council protocols or programs associated with a potential risk are the first step to identify immediate adjustments to alleviate or eliminate risks. Where adjustments to current practices will not sufficiently address the risks more substantial actions will be identified and implemented.

Of utmost importance to the successful implementation of this adaptation strategy is to communicate the issues and proposed responses to the community. Studies repeatedly show that a knowledgeable community that understands how to respond to extreme events is far more resilient to the impacts. An informed community is also more likely to implement their own programs and decisions that reflect their knowledge of the projected changes and enable them to contribute to developing a prosperous, liveable and affordable city in the face of climate change.

Integrating Adaptation Measures into Planning

- ***Integrate climate projections into Multijurisdictional Hazard Assessments and the City's Office of Homeland Security.*** *This will ensure adequate planning and preparation for more frequent and intense extreme events (such as wildfires, heat waves and storms)*
- ***Raise community awareness of the need for adaptation*** *and highlight actions they can take in their home and workplace to support and strengthen the City's climate change response.*
- ***Understand the communication and risk disclosure requirements*** regarding impact vulnerability and land title for existing and prospective owners
- ***Identify strategic planning processes that should be revised*** to incorporate climate resilience considerations

Protecting Public Health

Public health is arguably the most important concern and multidimensional issue to address in response to climate change. Understanding how extreme events may affect human health and what can be done to protect those vulnerable is fundamental to a successful adaptation strategy. From air quality issues due to wildfires causing respiratory illnesses, or heat waves causing heat stress illness and deaths for residents, tourists and outdoor workers, or flooding or wind storm events causing injury and death, public health is at risk from many aspects of climate change.

Other public health risks will arise due to increasing ambient temperatures which can affect water quality, particularly in times of drought, increase food and vector borne diseases, and potentially cause drought stressed trees to drop branches, or lose branches in wind storms, causing injury or death.

Flooding can inundate wastewater systems contaminating water sources, or cause the dispersion of waste at collection points creating considerable health risks.

These health issues are largely avoidable and therefore public education programs, early warning systems and protective measures can help to alleviate these important issues.

High priority risks include:

- ***Consider the potential increase in vector borne disease*** *by reviewing current alert systems with health services and/or CDC to identify effective improvements; work with health services to develop a communications campaign to educate the community about risks, precautions and symptoms; engage environmental health workers to identify and monitor known or potential breeding sites.*

- ***Consider the potential increase in water borne disease*** *by reviewing current treatment and monitoring programs; assess impact of rising temperatures on water quality and potential associated impacts to public health.*

- ***Address increased risk of water and food borne disease at outdoor events*** *in warmer temperatures by reviewing current food preparation and storage requirements for outdoor events or temporary stalls and revising accordingly; include health issue advice in any relevant event permit applications to ensure awareness of issue; work with health providers to develop public awareness campaign.*

- ***Consider potential respiratory illness, injury or death due to wildfires*** *by collaborating with wildfire authorities, health services and regional districts to identify shared vulnerabilities and responses; review current air quality warning system and revise if necessary; develop school education program and protocols with regard to wildfire affected air quality days.*

- ***Assess potential water quality issues due to wildfires in water catchments,*** *which can also significantly reduce run off and affect water supply availability, by collaborating with water suppliers and authority to review vulnerability. Consider new alternatives and negotiate revised share agreements; consider potential water restrictions policy related to wildfire incidents.*

- ***Address potential increased incidences of heat stress illness and death at recreational, tourism or sporting events during heat waves*** *by reviewing current heat wave response plans and revising if necessary; consult with health and emergency services to ensure alignment; involve event sector to maximize compliance.*

- ***Address potential increased incidences of heat stress illness and death in the community during heat waves*** *by working with aged care, children and social welfare services and health providers to create collaborative prevention awareness campaign. Coordinate and promote 'coolsafe' venues with proprietors and health services; review city policy for outdoor workers and prepare regionally aligned heat wave plan; promote early in the season to maximize community preparedness; require health services to record and report heat stress related illness and death to monitor impacts and results.*

Maintaining Water Supply and Services

Adequate water supply is a fundamental requirement for every community. Like many other Californian cities, San Diego's water challenge is meeting ever-increasing demand with a projected declining supply. By 2030 the San Diego Water Authority projects an increase in water demand of 24%, including the expected realization of a 12% per capita demand reduction. 70% of that 2030 demand is expected to be met by imports. By 2050, the expected increase in demand is 37% over 2005 levels and will require some 80% from imports; however, that does not take into account the expected increase in demand in drought years. Nor does it take into account the projected supply reductions by 2050 due to climate change that currently shows a shortfall in supply of approximately 20%. This is of course of serious concern to San Diego.

Adaptation efforts regarding adequate water supply clearly need to focus on reducing demand and increasing supply. In San Diego, 58% of water is used for residential purposes, which is expected to increase to approximately 66% by 2050. A significant amount of that water is used for landscaping, also a significant use at a municipal level. Therefore, water efficient landscaping is clearly a priority consideration for San Diego to adapt to climate change in this area and ensure sufficient water supply. Such a challenge requires the coordinated efforts of many stakeholders at government, industry and community level.

For the commercial and industrial sector, which consumes approximately a third of the supply, conservation and efficiency efforts should focus on the largest users to gain the most significant results.

With drought years expected to double from now until 2050 and supplies in the Colorado River and Delta Basin expected to significantly decline, the significant consequence of inadequate or unaffordable water requires this issue to be addressed as a priority concern.

Short to medium term strategies include:

- ***Address potential shortfalls in future water supplies*** *by taking immediate steps to reduce reliance on water imports; review municipal, industrial and residential landscaping irrigation practices to identify reduction opportunities;*

- ***Promote water efficiency in new urban development*** *by reviewing development application guidelines to incorporate considerations of effects on water balance in development approval guidelines.*

Protecting Urban Infrastructure and Services

Urban infrastructure forms the structural and functional backbone of the city. A breakdown in that structural or functional integrity can cause a range of cascading consequences for residents, businesses or tourists. Roads, sidewalks, bridges, communications networks, sewer systems, transit systems and energy grids will all be affected by climate change impacts in different ways. It is important for the adaptation program to identify where the risks are most significant and which critical assets are most vulnerable. This will aid in prioritizing assets and actions to maintain service resilience.

For critical assets at significant risk, implementing climate resilient asset management strategies early will ultimately decrease the risk of asset damage and failure that in turn reduces or minimizes the recovery costs resulting from an extreme event. Where response measures are considered important but not urgent, aligning the implementation of the measures with asset management, maintenance and renewal cycles means costs can be streamlined. While there may be additional costs for the resilience measures themselves these costs are minimized when incorporated with already budgeted replacement and renewal initiatives. It is also important that adaptation measures be planned in the context of the expected life span of the asset and the timing of the projected impacts of climate change. This allows resilience measures to be staged as climate becomes more extreme as well as builds in flexibility to allow variations to the response measures that reflects updated science, revised risk ratings or observed trends.

Adaptation measures to be undertaken by the City to address infrastructure issues of high and medium priority in the short term include:

- ***Address potential subsidence and erosion affecting stability and safety of road assets in drought conditions*** *by aligning assessments with road maintenance schedules; consider project reduction in soil moisture to identify and address most vulnerable assets to address as a priority.*

- ***Consider potential damage or destruction public and private infrastructure due to wildfires*** *by collaborating with wildfire authorities and regional districts to identify key service vulnerabilities and redundancy options; review changes to risk profile with insurers.*

- ***Consider potential power outages in heat waves*** *due to demand exceeding supply and the flow on effects for building tenants, train passengers, other critical infrastructure by coordinating with building managers and tenants, energy providers, train authorities and emergency services; promote energy efficiency in heat wave conditions; understand network capacity and projected demand.*

- ***Assess potential for blocked access in low-lying areas due to flash flooding*** *impacting residents, emergency services, local businesses, distribution networks, and through traffic causing mass delays. Consider seasonal drainage issues, additional pumping capacity and protocols in critical areas, highlight alternative routes and review emergency warning systems and traffic management.*

- ***Address potential building and asset damage due to flash flooding in low lying areas*** *surpassing drainage capacity, by reviewing flood preparedness programs,, review drainage capacity and climate projections, promote flood preparedness in development approvals, assess stormwater harvesting potential to alleviate drainage issues and water supply pressures.*

- ***Consider potential heat stress and damage to infrastructure in heat waves*** *including thresholds for warping of electricity network, bridge supports and train tracks, by relevant asset owners and authorities to identify risks and extreme event protocols.*

Protecting Environmental Health

Environmental health is of significant importance to the community. Healthy natural water systems, vegetation areas, wetlands, estuaries and the biodiversity that lives there, as well as air quality, all provide important ecosystem services to the surrounding districts and residents. In San Diego, environmental health also contributes to tourism, water sport industries, recreational and commercial fishing, marine industries and public events. Any decline in environmental health will likely also result in a negative effect on these social and economic activities.

Balancing the needs of the environment with the needs of the community is of critical importance and understanding how climate change may further challenge that balance will identify key issues and priority adaptation actions. Changes to pest and weed prevalence may be a key issue with rising temperatures and reduced water availability; this can have considerable flow on effects for indigenous flora and fauna species. Working with local universities to develop monitoring programs can be a useful and cost effective collaboration to address the problem and develop innovative solutions tailored to the emerging issues.

Adaptation measures to protect our environmental health in the short to medium term will include:

- ***Address potential for increased invasive weed and pest prevalence*** *due to rising temperatures and changes to rainfall patterns which can impact on biodiversity health and maintenance costs; review and if necessary revise current invasive weed and pest management plans to address projected changed conditions, consider potential increase maintenance and resource requirements.*

- ***Address increased risk of pollution from open waste sites being dispersed due to intense rainfall events*** *by reviewing vulnerability of current waste collection sites to storms and excessive rainfall; identify potential pollution channels and steps to prevent contamination; promote good waste practices upstream in the community.*

Maintaining Parks, Recreation and Wellbeing

For San Diego, our parks are a key attribute of our culture and character. Our urban green spaces provide recreational and tourism appeal as well as alleviate the heat island effect and intense flooding events. Unfortunately, they also require significant irrigation and perhaps warrant replanting to more drought resistant plants as well as more strategic watering to balance their appeal and health with competing water needs.

Recreation and wellbeing also contributes substantially to our experience of our society and quality of life. Local governments through community services, parks and recreational programs and other services support and enable social cohesion, identity and lifestyle. To have our opportunities for recreation threatened or limited or our wellbeing hindered through negative impacts to our health or environment can have significant impacts on our quality of life and sense of community.

Extreme temperatures create health risks for outdoor sports activities and harden sporting fields causing more frequent and significant injuries. Losing our sporting activities at certain times of the year would also lose the community cohesion and health benefits that they create.

Rising temperatures threaten the viability of certain plant and tree species and temperature sensitive animal species such as birds, frogs and butterflies. Drought can stress trees causing branches to fall with potential risk of injury. If trees die, then the experience of recreational spaces is altered.

It is important that the impact extreme climate events or changing climatic conditions can have on recreational space or activities and the effect that can have on lifestyle and wellbeing is understood. Recreational alternatives or protection strategies can help to maintain what is often overlooked for the importance it contributes to a community's identity and social capital. Adaptation strategies that highlight these effects and recognize the value response measures can contribute are likely to be more successful overall in maintaining a city's appeal and character.

Coastal Management and Protection

The prospect of sea level rise, as well as coastal erosion and storm surge as it advances, is a significant issue for all low-lying, soft shore coastal districts. This complex issue is challenging to address. The competing demands of coastal development and community protection provide an ongoing tension that features diverse interests and objectives.

Identifying existing properties and areas that climate change projections for sea level rise propose will be frequently flooded and later inundated provides the opportunity to consider protection and retreat strategies. However, it is also important to consider that such strategies can compromise current land values, insurability and finance options. These potential shocks to current landholders and property owners can result in legal challenges and community upset that can further delay effective action.

In 2009, the California State Lands Commission confirmed that the 'gradual and imperceptible' increase in sea level rise would see the shifting shoreline also move the sovereign land boundaries in the eyes of California law. How this will translate to property ownership or evacuation obligations is yet to be defined but it is clear the state will have the legal authority to determine whether and when a property is to be evacuated and removed.

Some communities are currently experimenting with establishing setback lines that determine where the new coastal frontier will be. In doing so agreements are made with existing or potential property owners on the coastal side of that line, establishing a permit or leasehold that has a trigger point attached to it that determines when the permit holder is required to evacuate and dismantle the property.

Dune vegetation has been shown to be very effective in some districts to slow or negate beach erosion and protect properties behind the dune and often aligns with the setback line. Beach replenishment is another option to combat erosion, and is already being undertaken in San Diego; however, it is costly and ongoing. Sea walls and levees can have isolated and even temporary protective effect however can often cause issues for contiguous coastal communities. It is therefore considered more effective for coastal districts to collaborate strategies and resources to develop coordinated, long-term coastal protection strategies. Working with other coastal authorities to develop a cohesive strategy is likely to have the best outcome with regard to coastal protection, cost effectiveness, community acceptance and minimized liability.

While protection measures can be somewhat gradual or progressive, ensuring no unsuitable development is undertaken in known vulnerable areas should be a key priority to limit future damages and public risk.

Estuaries and wetlands at risk of inundation threaten both the local species as well as the ecosystem services the area provides. Evaluation and monitoring programs will be key to managing the impacts and developing appropriate response strategies.

Adaptation measures in the short to medium term include:

- ***Address potential inundation and erosion of soft shore, low lying coastal residential and recreation areas*** *that will damage assets and displace residents; consider potential coastal protection measures and associated impacts.*

- ***Consider potential inundation and erosion of soft shore, low lying coastal business and tourism areas*** *which will cause economic losses by aligning with the recommendations and program; consider potential coastal protection measures and associated impacts; work with local businesses to identify opportunities for retreat.*

- ***Consider potential inundation and erosion of soft shore, low lying coastal estuaries and wetland areas*** *which will endanger local biodiversity and ecosystem services by working with relevant agencies to establish assessment and protection principles and protocols; ensure consideration of ecosystem services in assessing vulnerability and values.*

Future Proof Planning and Development Approvals

City planning and urban development is fundamental to a city's character, growth and prosperity. This framework is a key factor influencing the level of consequence from climate change impacts. Planning and urban design can determine if local topography will result in flooding which inundates buildings and/or blocks access in or out of an area or if the design will incorporate natural drainage basins and water features that alleviate flooding and irrigate parks and recreational space in times of drought. Green space ratios and shade levels enhance the city aesthetic as well as alleviate the heat island effect, and coastal developments can either be carelessly or prudently located through planning approvals.

Development approvals that increase population densities to a point that unduly pressures water and energy supplies, contribute to the heat island effect or increase wildfire risk work against good adaptation strategies and increase a city's risk profile. Development approvals that align with or embody appropriate adaptation responses build climate-ready communities that work with the natural environment and conditions rather than in spite of them and thus build our resilience to climate change.

Infrastructure and city planning has the ability to either increase vulnerability or increase resilience. Poor development decisions also have the potential to expose the City to liability for damages should adverse outcomes result from extreme events that a court may deem should have been anticipated. A review and revision of all planning and development policies to consider climate change impacts ensures appropriate development and climate ready communities.

CONCLUSION

The information provided serves to illustrate the choices that face San Diego. A recommendation is to put forward a plan that encourages the changes required to achieve GHG reductions, and evaluate the success in 2014. If voluntary measures do not result in the necessary reductions, then options for increasing participation levels will be reviewed. As noted in APPENDIX TWO, there are ways by which the targets can be met. The development of a successful strategy requires that all sectors of the community and key stakeholders be involved in the process. The 2020 target must be met, as per State law. The CMAP extends through 2035, and will keep GHG emissions in check as the population increases. However, that is not enough to get on the trajectory to GHG reduction levels for 2050.

APPENDIX ONE: Mitigation Measures and Comparative Participation Levels

	CURRENT SCENARIO		ENHANCED LOCAL		ACHIEVE 2035 SCENARIO	
	INPUTS		INPUTS		INPUTS	
Local Measures - Buildings	2020	2035	2020	2035	2020	2035
Commercial Retro-Commissioning						
Average Energy Reduction (%)	15%	15%	15%	15%	15%	15%
% Commercial SF	20%	40%	20%	100 %	20%	100 %
Commercial Efficiency Retrofits						
Energy Reduction (%/unit)	30%	30%	30%	50%	30%	50%
Area Retrofit (% of SF)	20%	50%	20%	100 %	20%	100 %
Residential Efficiency Retrofit - Single Family (SF)						
Energy Reduction (%/unit)	30%	30%	30%	50%	30%	50%
Number of Units Retrofit (% total units)	20%	50%	20%	100 %	20%	100 %
Residential Efficiency Retrofit - Multi Family						
Energy Reduction (%/unit)	30%	30%	30%	50%	30%	50%
Number of Units Retrofit (% total units)	20%	50%	20%	100 %	20%	100 %
Residential Solar Water Heating Retrofit - SF						
Number of Units (% total units)	10%	25%	10%	100 %	10%	100 %
Commercial Solar Water Heating Retrofit						
Reduction in water heating energy	50%	50%	50%	50%	50%	50%
% commercial water heating energy affected	10%	25%	10%	100 %	10%	100 %
Residential PV						
Total Capacity (MW)	50	300	50	600	50	600
Commercial PV						
Total Capacity (MW)	150	400	150	600	150	600
Cogeneration (MW)						
Total Capacity (MW)	200	300	200	500	200	500
Residential New Construction						

APPENDIX ONE: Mitigation Measures and Comparative Participation Levels	CURRENT SCENARIO		ENHANCED LOCAL		ACHIEVE 2035 SCENARIO	
% better than T24	15%		15%		15%	
Participation Rate after 2015	100 %		100 %		100 %	
Commercial New Construction						
% better than T24	15%		15%		15%	
Participation Rate after 2015	100 %		100 %		100 %	
Water Use Efficiency						
Gal/person/day	142	116	142	103	142	103
City Building Efficiency						
% reduction in total energy consumption	20%	30%	20%	30%	20%	30%
Local Measures - Transportation	2020	2035	2020	2035	2020	2035
Mass Transit						
% mode share	5%	6%	8%	20%	8%	25%
Bicycle Intrastructure						
Bicycle lanes per square mile	4	8	4	8	4	8
Parking - reduce spaces						
% of total reduced Metro area	10%	20%	10%	20%	10%	20%
Parking - preferred parking for Evs						
% reserved for electric vehicles	10%	20%	10%	20%	10%	20%
Parking - Increased fees						
$ per day	24	30	24	30	24	30
SB 375 - telecommute, carpool, vanpool, buspool, bottleneck relief, HOV/HOT lanes, safe routes to school only.						
% of target achieved	100 %	100 %	100 %	100 %	100 %	100 %
Signal timing and roundabouts						
Number of signals and roundabouts, each	15	20	15	20	15	20
Electric Vehicles						
% miles driven of personal miles	4%	11%	4%	15%	4%	15%

APPENDIX ONE: Mitigation Measures and Comparative Participation Levels

	CURRENT SCENARIO		ENHANCED LOCAL		ACHIEVE 2035 SCENARIO	
Local Measures - Land Use	2020	2035	2020	2035	2020	2035
Smart Growth						
% increase in population density from 2010	12%	27%	12%	27%	12%	27%
Local Measures - Waste	2020	2035	2020	2035	2020	2035
Divert Trash and Capture Landfill Gas						
% landfill gas capture	80%	80%	80%	80%	80%	80%
% wastewater gas capture	98%	98%	98%	98%	98%	98%
State/Federal Measures	2020	2035	2020	2035	2020	2035
Renewable Portfolio Standard						
% of sales that is renewable	33%	33%	33%	33%	33%	50%
Corporate Average Fuel Efficiency (federal)						
MPG for New Passenger Vehicles	35.5	35.5	35.5	35.5	35.5	51.5
Low-Carbon Fuel Standard						
% reduction in carbon intensity	10%	10%	10%	10%	10%	10%
CARB Tire Pressure Program						
% CARB goal achieved	100 %	100 %	100 %	100 %	100 %	100 %
CARB HDV Regulation (% target achieved)						
% CARB goal achieved	100 %	100 %	100 %	100 %	100 %	100 %

APPENDIX TWO: Cost Analysis for Mitigation Measures

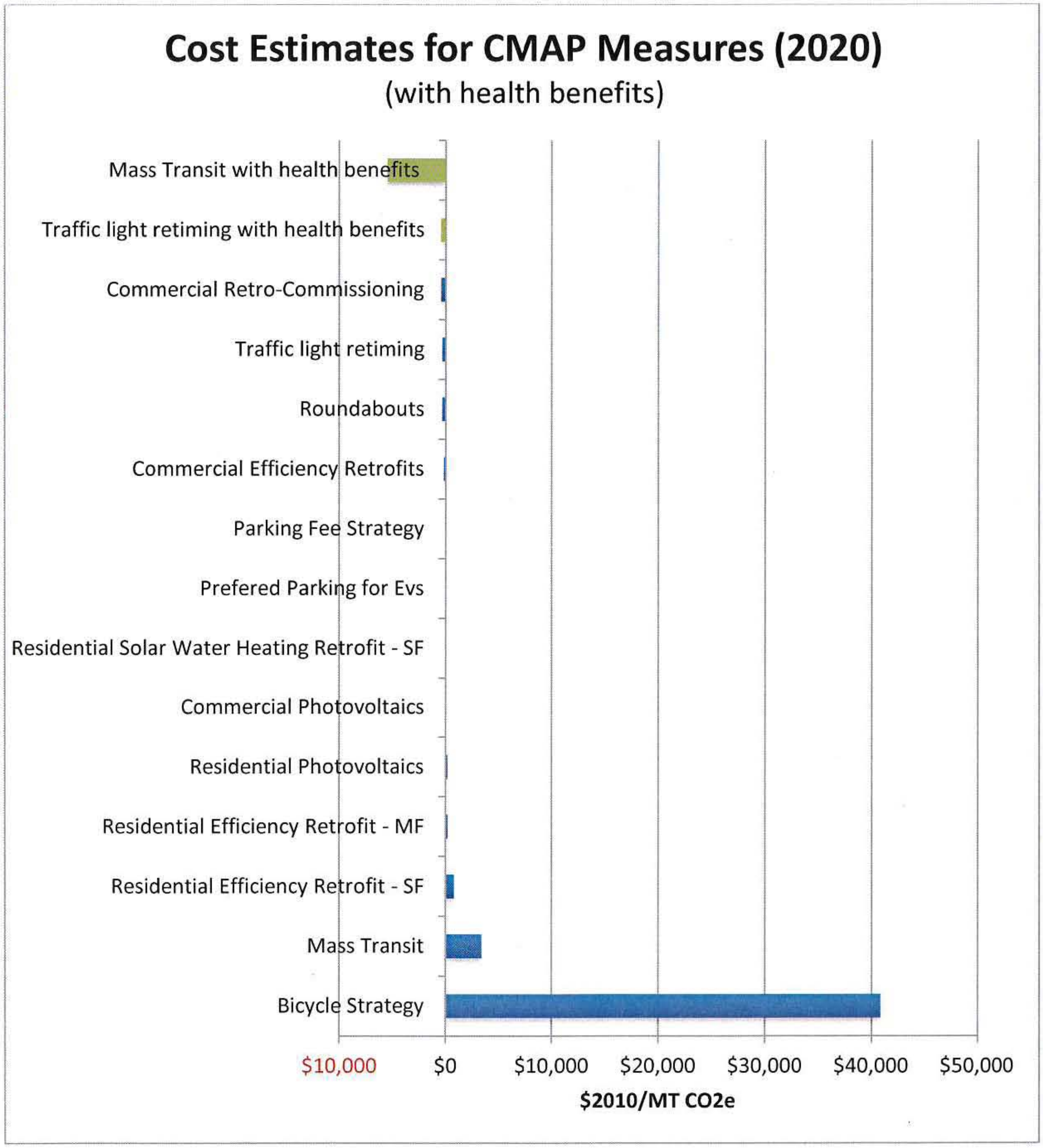
Cost Effectiveness of CMAP Measures ($2010/MT CO2e)

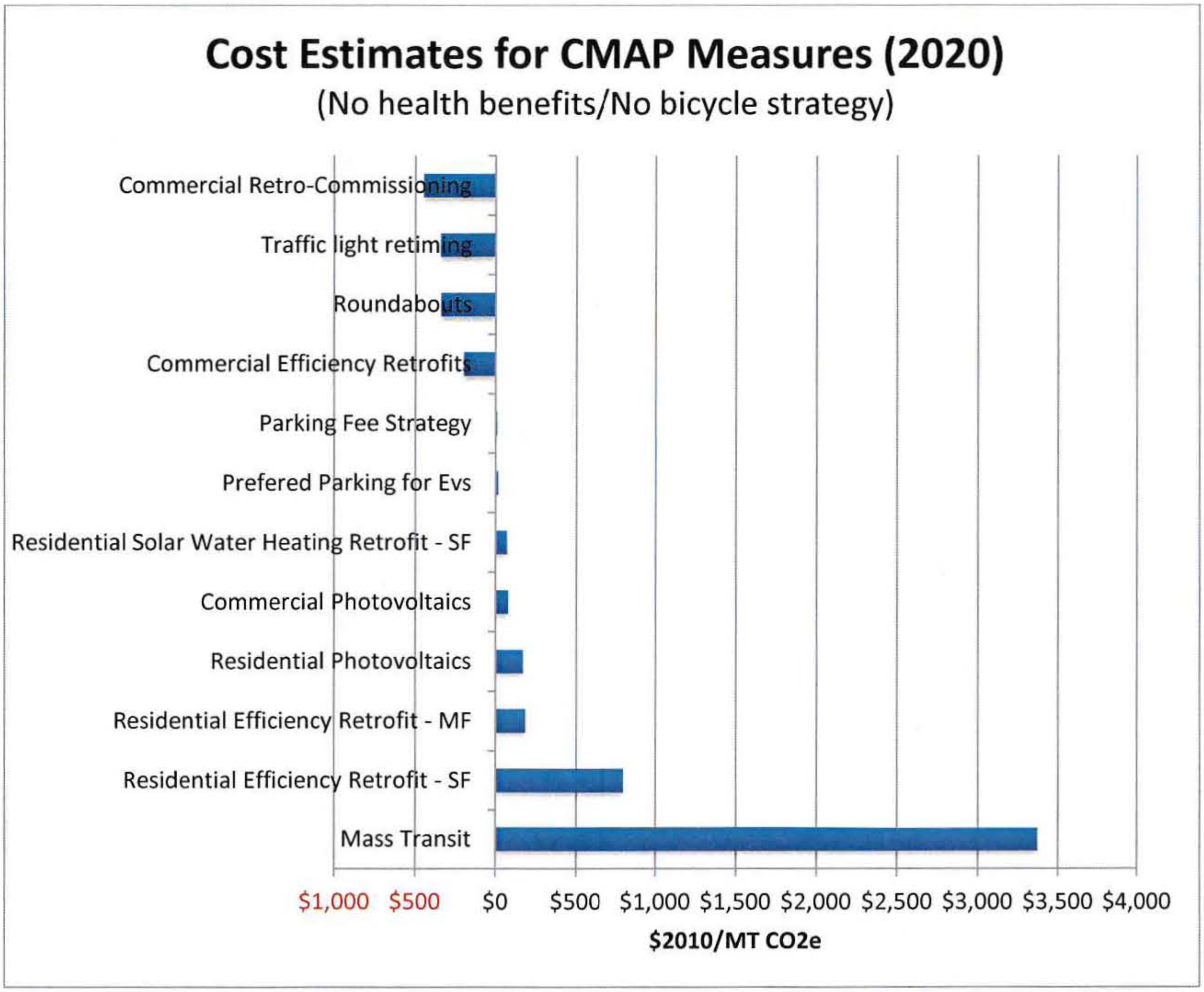
Electric/Natural Gas Measures	**2010**	**2020**
Commercial Retro-Commissioning	($489)	($448)
Commercial Efficiency Retrofits	($216)	($198)
Residential Solar Water Heating Retrofit - SF	$128	$71
Residential Efficiency Retrofit - MF	$185	$187
Commercial Photovoltaics	$244	$80
Residential Photovoltaics	$329	$171
Residential Efficiency Retrofit - SF	$782	$800

Transportation Measures	**2020**
Mass Transit with health benefits	($5,485)
Traffic light retiming with health benefits	($457)
Traffic light retiming	($341)
Roundabouts	($340)
Parking Fee Strategy	$9
Preferred Parking for Electric Vehicles	$15
Mass Transit	$3,372
Bicycle Strategy	$40,864

Note: Because of the difference in methodology, no 2010 values are available for transportation measures.

NOTE measures with health benefits included are in green.



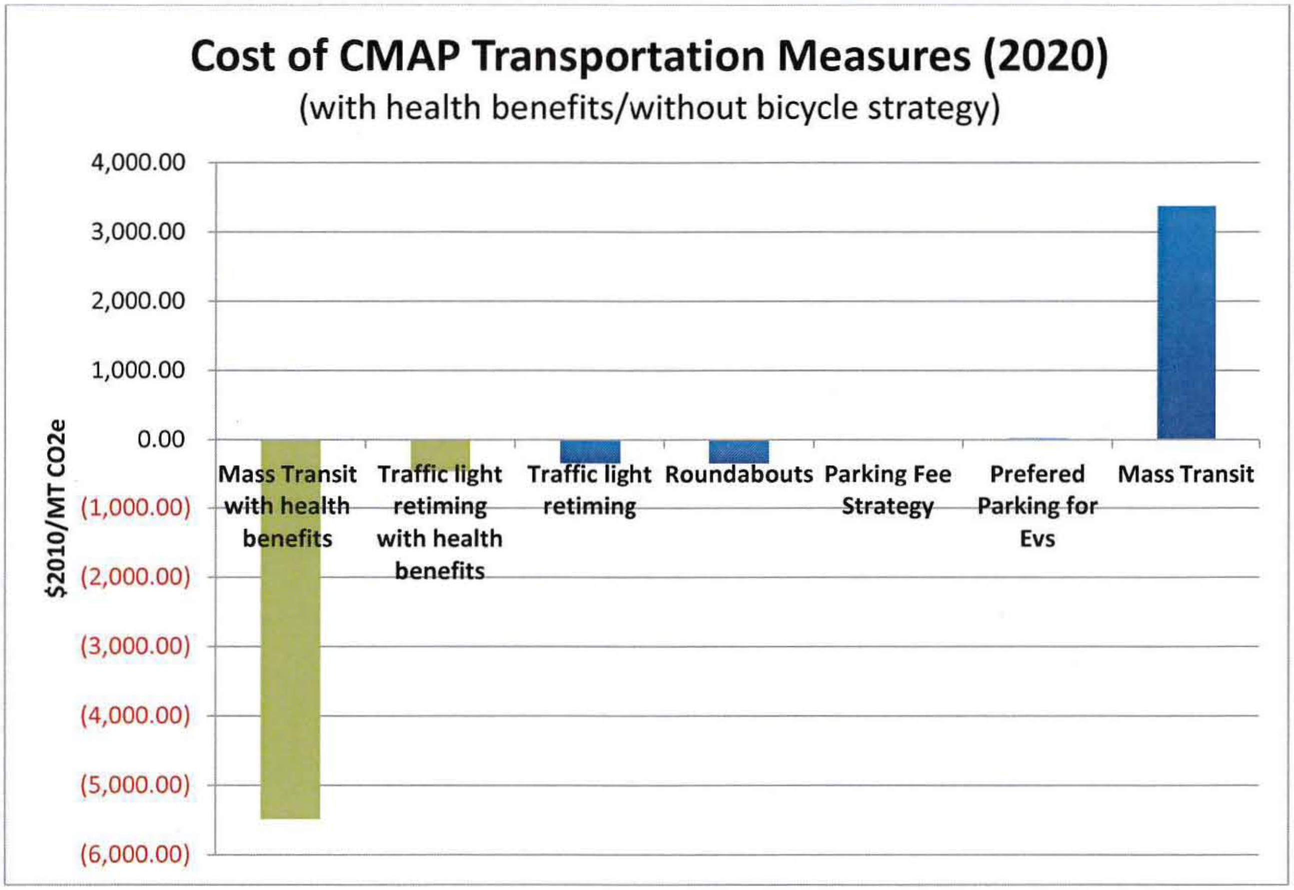

Cost Estimates for CMAP Measures (2020)
(No health benefits/No bicycle strategy)
Commercial Retro-Commissioning
Traffic light retiming
Roundabouts
Commercial Efficiency Retrofits
Parking Fee Strategy
Prefered Parking for Evs
Residential Solar Water Heating Retrofit - SF
Commercial Photovoltaics
Residential Photovoltaics
Residential Efficiency Retrofit - MF
Residential Efficiency Retrofit - SF
Mass Transit
$1,000 $500 $0 $500 $1,000 $1,500 $2,000 $2,500 $3,000 $3,500 $4,000
$2010/MT CO2e

Electric/Natural Gas Measures - Cost Results for Current Scenario

This represents the total net cost or savings that would result if the level of penetration in the *current scenario* are achieved.

	INPUTS 2010	INPUTS 2020	COST ($2010/ MTCO2e) 2010	COST ($2010/ MTCO2e) 2020	L-M-H Scale 2010	L-M-H Scale 2020	TOTAL Net Cost or (Savings) 2010	TOTAL Net Cost or (Savings) 2020
Commercial Retro-Commissioning			($489)	($448)	L	L	($20,441,553)	($18,729,321)
Cost ($/SF)	$ 0.55	$ 0.55						
Average Energy Reduction (%/SF)	15%	15%						
% Commercial SF	2%	20%						
Commercial Efficiency Retrofits			($216)	($198)	L	L	($9,028,773)	($8,299,606)
Cost ($/SF)	$ 2.25	$ 3.38						
Energy Reduction (%/SF)	20%	30%						
Area Retrofit (% of SF)	5%	20%						
Residential Efficiency Retrofit - SF			$782	$800	H	H	$32,678,291	$33,452,089
Cost ($/unit)	$ 13,000	$ 13,000						
Energy Reduction (%/unit)	30%	30%						
Number of Units Retrofit (% total units)	1%	20%						
Residential Efficiency Retrofit - MF			$185	$187	M	M	$7,750,433	$7,816,474
Cost ($/unit)	$ 4,000	$ 6,000						
Energy Reduction (%/unit)	20%	30%						
Number of Units Retrofit (% total units)	1%	20%						
Residential Solar Water Heating Retrofit - SF			$128	$71	M	M	$5,369,536	$2,987,178
Cost ($/collector)	$ 6,500	$ 6,000						
Number of Units (% total units)	1%	10%						
Residential PV			$329	$171	M	M	$13,755,913	$7,155,995
Cost ($/watt)	$ 8.00	$ 6.00						

Total Capacity (MW)	25	50					
Commercial PV			$244	$80	M	M	$10,193,499	$3,362,953
Cost ($/watt)	$ 7.00	$ 5.00					
Total Capacity (MW)	50	150					



APPENDIX THREE: Adaptation Summary

Impact	Theme	Subtheme	Implication/Consequence	Sensitivity
all impacts	Municipal	Operations	Highlight climate change profile within government and combine with sustainability agenda and risk management	
all impacts	Municipal	Operations and Community	Integrate climate projections into Mutijuridictional Hazard Assessments and City's Office of Homeland Security	
all impacts	Municipal	Operations	Raise awareness in community of need for adaptation and actions that can be undertaken at home and business to support City goals	
Increased temp	Public Health	Community	Increased temp and changes to rainfall may affect prevalence of vector borne disease and health of waterways	Current prevalence of VBD and % of population vulnerable; existing health of water system; capacity for community to pay for additional treatment costs
Increased temp	Public Health	Water	Increased temp and changes to rainfall may affect prevalence of water borne disease (causing health risks and increased treatment costs and potential liability)	Current prevalence of WBD and ability to monitor and treat
Increased temp	Public Health	Recreation and events	Increased risk of water and food borne disease at outdoor events esp temporary food stalls	# events and attendees
Increased temp	Natural Env	Biodiversity	Changing temps and rainfall patterns may have adverse impacts on biodiversity creating worsened and new pest and weed problems	Propensity for weeds and pests to be introduced to local habitat
Drought	Water	Water Supply	Insufficient urban water supply	% homes with raintanks installed extent local industry reliance on urban water supply community willingness and capacity to pay more for water availability of alternative water sources vulnerability of imported water sources
Drought	Natural Env	urban green spaces	Dead green spaces / loss of community use and pride / loss of tourism	% green space reliant on current rainfall or irrigation

APPENDIX THREE: Adaptation Summary

Impact	Theme	Subtheme	Implication/Consequence	Sensitivity
Drought	Public Health	Food Security	Food systems altered due to global climate change and food scarcities	agriculture reliant on current rainfall or irrigation
Drought	Natural Env	urban green spaces	Stressed trees dropping branches causing damage or injury (potential City liability)	# trees in city district
Drought	Development	Water	City approving new developments whose water requirements collectively outstrip available supply for existing population	Potential for new developments approved with significant water use profile
Drought	Infrastructure	Roads	Potential subsidence or erosion undermining road stability and safety	# roads with unsealed shoulders
Wildfire	Infrastructure	Community	Damaged or destroyed public and private infrastructure and assets due to wildfire (resulting in financial impacts to residents and owners, pressures on welfare services, and temporary housing)	% infrastructure and assets at risk of wildfire (including city supporting services outside district area)
Wildfire	Public Health	Community	Potential injury or death due to wildfire, as well as air quality issues causing respiratory issues and health implications	# residents living in vulnerable areas; % population vulnerable to respiratory issues
Wildfire	Public Health	Water	Wildfires in water catchments causing water quality issues, reducing run off and threatening water availability	Extent of water catchments (including for imports) vulnerable to wildfires
Extreme Events	Energy	Buildings	Power outage due to demand exceeding supply causing building evacuations; train stoppages and passenger strandings; loss of air con to community cool spaces (eg shopping centres, libraries and movie theatres)	Capacity of energy system vs peak load in heatwave on weekday
Extreme Events	Public Health	urban green spaces	Increased incidence of heat stress illness and death in outdoor urban areas exacerbated by lack of shade protection	% population in vulnerable groups not able to retreat to coolsafe areas during heatwaves and having to traverse unshaded streets or areas; capacity of health system to respond

APPENDIX THREE: Adaptation Summary

Impact	Theme	Subtheme	Implication/Consequence	Sensitivity
Extreme Events	Public Health	Recreation and events	Increased incidence of heat stress illness and death at recreational, tourism and sporting events	# vulnerable population groups at outdoor events during heatwaves
Extreme Events	Public Health	Community	Increased incidence of heat stress illness and deaths across community (including outdoor workers)	% population in vulnerable groups not able to retreat to coolsafe areas during heatwaves (elderly, ill or infirm, economically disadvantaged including homeless, outdoor workers, some cultural groups); capacity for health system to respond; % air conditioned or insulated housing; response capacity if power fails
Extreme Events	Infrastructure	Roads	Flash flooding blocking access or thoroughfare of residents, supplies, business distribution or emergency services resulting in adverse health outcomes	# roads with no or few alternative routes to or from health services
Extreme Events	Infrastructure	Buildings	Flash flooding due to surpassing drainage capacity causing extensive building and asset damage; potentially injuries and fatalities	Amount of redundancy built into drainage systems to account for intense rainfall events
Extreme Events	Waste	Environment	Increased risk of pollution from open site waste disposal being inundated and dispersed	Extent of exposed waste disposal
Extreme Events	Water	Wastewater	Potential inundation of wastewater causing overflow resulting in adverse health or environmental issues	Wastewater systems vulnerability to flash flooding inundation
Sea Level Rise	Infrastructure	Coastal	Flooding / inundation / beach loss of low-lying coastal residential areas	# residents and homes vulnerable to inundation; ability for homes to be protected; insurance coverage; capacity for residents to retreat

APPENDIX THREE: Adaptation Summary

Impact	Theme	Subtheme	Implication/Consequence	Sensitivity
Sea Level Rise	Infrastructure	Coastal	Flooding / inundation / beach loss of low-lying coastal business and tourism areas causing damage and economic losses	# businesses, employment and local revenue generated by vulnerable properties; insurance coverage; capacity to recover from damages and closure
Sea Level Rise	Natural Env	Coastal	Flooding / inundation of coastal estuaries and wetlands endangering local biodiversity	Ability for species to live in saline conditions; ability for species to retreat; resilience of vegetation buffers protecting the area

APPENDIX FOUR: CMAP Greenhouse Gas Mitigation Strategies

This document provides information about the data, methodologies, and sources used to estimate the greenhouse gas reductions associated with the measures included in the City of San Diego Climate Mitigation and Adaptation Plan (CMAP). Calculations were done for a series of city-based measures leading to GHG emissions reductions from electricity and natural gas, on-road transportation, land use and waste. Table 1 provides a summary of all the CMAP measures and their contribution to he overall reduction.

Table 1. Summary Table of CMAP Mitigation Strategies

	2020		2035	
LOCAL MEASURES	**MT CO2e Reduction**	**% of total Reduction**	**MT CO2e Reduction**	**% of total Reduction**
Energy				
Residential Efficiency Retrofits	105,774	3%	300,619	4%
Commercial Efficiency Retrofits	83,663	2%	237,601	4%
Commercial Retrocommissioning	41,812	1%	95,040	1%
New Construction Efficiency	23,895	1%	-	0%
Residential Solar Water Heaters	19,058	0%	44,745	1%
Comercial Solar Water Heating	6,654	0%	20,724	0%
Clean and Efficient Distributed Generation	84,266	2%	345,012	5%
Water Use Efficiency	6,846	0%	43,265	3%
City Facility Efficiency Retrofits	13,335	0%	18,818	0%
Transportation				
Mass Transit	61,798	2%	77,124	
Bicycle Intrastructure	17,000	0%	43,780	1%
Parking - reduce spaces	30,782	1%	58,026	1%
Parking - preferred parking for Evs	42,621	1%	80,344	1%
Parking Increased fees	110,474	3%	147,922	2%
SB 375 (telecommute, carpool, vanpool, buspool, bottleneck relief, HOV/HOT lanes)	348,000	9%	866,000	6%
Signal timing and roundabouts	3,571	0%	4,761	0%
EV use	219,000	5%	606,000	5%
Convert municipal fleet to EV	13,000	0%	24,000	0%
Land Use				
Smart growth - population density	69,062	2%	74,188	2%
Waste				
Divert Trash and Capture Landfill Gas	485,838	12%	608,924	13%
Total City Measures	**1,786,448**	**44%**	**3,696,893**	**54%**

STATE MEASURES				
Energy				
Renewable Portfolio Standard	505,616	13%	563,730	11%
Transportation				
CAFE	1,142,000	28%	2,059,000	21%
LCFS	540,000	13%	528,000	11%
CARB Tire Pressure Program	30,670	1%	26,201	0%
CARB HDV Aerodymanics	9,970	0%	11,083	0%
Total Statewide Measures	**2,228,256**	**56%**	**3,188,014**	**46%**
TOTAL GHG REDUCTIONS	**4,014,704**	**100%**	**6,884,907**	**100%**

COMMON ASSUMPTIONS AND SOURCES

A set of common assumptions and sources was used to calculate emissions reductions.

Electric/Natural Gas Measures

The following assumptions were used in calculating greenhouse gas reductions for measures related to electric and natural gas.

Common Assumptions for Electric and Natural Gas Measures

- **Greenhouse Gas Intensity of Electricity** – The calculations include a dynamic greenhouse gas intensity of electricity in pounds per megawatt-hour (lbs/MWh). For example, as the percentage of electricity provided by renewable energy sources increases the greenhouse gas intensity of electricity falls. Consequently, each reduction in energy use yields a smaller greenhouse gas reduction. This calculation also includes the effects of increased electricity use for electric vehicles, which results in a reduction in emissions in the transportation sector and an increase in emissions in the electric sector.
- **Transmission Losses** – All electricity values include transmission losses of 7.5%.
- **Allocation of Energy Use in the Residential Sector** – The CMAP estimates assume that the total energy budget of the average residential unit is comprises 46% electricity use and 54% natural gas use.
- **Allocation of Energy Use in the Commercial Sector** - The CMAP estimates assume that the total energy budget of the average residential unit is comprises 70% electricity use and 30% natural gas use.

Common Sources for Electric and Natural Gas Measures

- Kavalec, Chris and Tom Gorin, 2009. California Energy Demand 2010-2020, Adopted Forecast. California Energy Commission. CEC-200-2009-012-CMF, available at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/index.html.

On-Road Transportation

Common Assumptions for Transportation Measures

- **Vehicle Miles Traveled** (VMT)– VMT data was provided by the City of San Diego for the years 1990, 2004, 2007, 2008 and 2009. VMT forecasts for 2010, 2020 and 2035 were made on the basis of the regional planning agency's (SANDAG) population growth forecast for the City.
- **EMFAC Model 2007** and **Pavley I and Low Carbon Fuel Standard Post Processor Version I**– EMFAC 2007 is an Emissions Factors model used California-wide by all its regional transportation planning agencies to calculate air pollutants, including carbon emissions, from all on-road vehicles on all roads. EMFAC 2007 combines tested vehicle emission rate data with regional vehicle activity to provide greater accuracy for regional emissions. We used the EMFAC 2007 model to obtain the business as usual GHG emissions for the region using SANDAG's local input data files for 2020 and 2035. The output emissions data were fed into the California Air Resources Board (CARB) Post Processor to obtain CO2 reduction amounts in the region. The regional CO2 reductions from the Post Processor reflect changes expected from federal and state mandates in 2020 and 2035: the Pavley I standards (equivalent to mpg changes in CAFE), and the state Low Carbon Fuel Standard (LCFS). It was assumed that the regional CO2e/VMT intensity was representative of the City.
- **Greenhouse Gas Intensity** – Dividing the regional CO2e by the regional system wide VMT provided the CO2e/VMT emissions factor, a greenhouse gas intensity factor, for the region. This factor adjusted for 4% miles driven by electric vehicles in 2020, and 11% EV miles in 2035. The effect of this (California Energy Commission) forecasted increased electric vehicles miles in 2020 and 2035 is to reduce the carbon intensity of vehicle emissions but this is offset to some extent by an increase in the electricity sector emissions. It was assumed that the regional CO2e/VMT was representative of the City's CO2e/VMT. This CO2e/VMT was used for the calculation of the GHG reductions from city measures that affect VMT. Because the carbon content of the fuel mix decreases with time, for example due to the state's Low Carbon Fuel Standard, the carbon intensity per mile also decreases. Consequently, with time, any future

measure yields a proportionally smaller greenhouse gas reduction. The CO2e/VMT factors are as follows:

CO2e/VMT Factors		
Post Pavley I (CAFÉ)	Post Pavley I (CAFÉ) and LCFS	Post 4% EV miles in 2020, 11% EV miles in 2035
4.225E-04	3.862E-04	3.714E-04
3.752E-04	3.439E-04	3.501E-04

Measures that depend on reduction in fuel consumption were converted to CO2e reductions using a factor of 1.013E-02 metric tons per gallon.

- **Business-as-Usual (BAU) Projection** – The BAU CO2e projection for on-road transportation derives from the SANDAG EMFAC forecast of the VMT for the City and the BAU carbon intensity per VMT in the region in the target year 2020 or 2035.

Sources

- EMFAC 2007 is an EPA approved model used by California to assess effectiveness of its vehicular emissions, available at http://www.arb.ca.gov/msei/documentation.htm. EMFAC Series 12 input files were provided by SANDAG and used in CARB's Post Processor. The Post Processor is available at: http://www.arb.ca.gov/cc/sb375/tools/postprocessor.htm.
- Elasticity data for the calculation of VMT reductions from local measures and price effects were obtained from: Reid Erwing and Robert Cervero (2010): Travel and the Built Environment, Journal of the American Planning Association 76:3, 265-294; and, Victoria Transport Policy Institute, Transportation Elasticities, available at: http://www.vtpi.org/tdm/tdm11.htm
- Bicycle strategies elasticity data were obtained from: Technical Appendices, Moving Cooler, An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions, Cambridge Systematics, October 2009

LOCAL MEASURES

Electric/Natural Gas Measures Methodology

Electricity consumption accounts for about 25% of Citywide greenhouse gas emissions, while natural gas accounts for about 17%. Because approximately 80% of electricity use and 90% of natural gas use is associated with buildings, many of the measures included in the City of San Diego CMAP target building energy use.

The City of San Diego CMAP includes 8 measures to reduce emissions from the electricity and natural gas categories. The following provides details about the data and methods used to calculate the energy and greenhouse gas emissions reductions.

Residential Efficiency Retrofits

The residential sector in the City of San Diego accounts for about 30% of electricity use and 33% of natural gas use. Much of this consumption is associated with existing buildings. This measure estimates the energy and greenhouse gas reductions associated with implementing energy efficiency retrofits in single family and multi-family homes.

- **Participation Rate and Average Energy Savings** – The CMAP assumes that 20% of existing residential homes are retrofit to reduce energy use by 30% per unit by 2020, and 50% of existing residential homes are retrofit for an energy savings of 30% per unit by 2035.
- **Pool of Homes for Retrofits** – It is assumed that all houses in San Diego County are eligible to be retrofit regardless of age. So, the target of reaching 50% means that 50% of all homes in the City of San Diego are retrofit.
- **Energy Reductions Calculation**- Energy reductions are calculated as a percentage of average residential energy consumption. The average residential electricity and natural gas consumption value is converted to million British thermal units (MMBTU) and combined to create a normalized energy consumption value. Reductions are calculated by taking a percentage of the normalized MMBTU value and then divided between electric and gas based on an average allocation between the two of 40% electric and 60% natural gas.

Sources:

- California Public Utilities Commission Database for Energy Efficient Resources (DEER), available at http://www.energy.ca.gov/deer/.
- Berkeley Residential Energy Conservation Ordinance, available at http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=16030.
- Meeting AB 32 - Cost-Effective Green House Gas Reductions in the Residential Sector. CONSOL, August 2008, available at http://www.consol.ws/studies.php.
- Critical Cooling, SPUR, February 2009, available at http://www.spur.org/publications/library/report/critical_cooling)

Commercial Efficiency Retrofits

The commercial sector accounts for 43% of electricity use and 25% of natural gas use in the City of San Diego. Much of this is associated with existing buildings. This measure estimates the energy and greenhouse gas reductions associated with implementing energy efficiency retrofits in commercial buildings.

- **Participation Rate and Average Energy Savings** – The CMAP assumes that 20% of existing non-residential square footage is retrofit to reduce energy use by 30% per square foot by 2020, and 50% of existing residential homes are retrofit for an energy savings of 30% per unit by 2035.
- **Percentage of Commercial Area that Can be Retrofit** – CMAP calculations assumes that all commercial area in San Diego County is eligible to be retrofit regardless of age. So, the target of reaching 50% means that 50% of all commercial square footage in the City of San Diego is retrofit.
- **Energy Reductions Calculation**- Energy reductions are calculated as a percentage of average commercial energy consumption per square foot. The average commercial electricity and natural gas consumption value is converted to million British thermal units (MMBTU) and combined to create a normalized energy consumption value. Reductions are calculated by taking a percentage of the normalized MMBTU value and then divided between electric and gas based on an average allocation between the two of 70% electric and 30% natural gas.

Sources

- SDG&E Standard Performance Contract program data for 2006 and 2007.
- California Public Utilities Commission Database for Energy Efficient Resources (DEER), available at http://www.energy.ca.gov/deer/.

Commercial Retro-commissioning

The California Energy Commission defines retro-commissioning as the process of "systematically investigat[ing] the operation of a building's energy consuming equipment to detect, diagnose, and correct faults in the installation and operation of commercial building energy systems." Retro-commissioning is typically only done in commercial buildings and is analogous to a tune up for a car.

- **Participation Rate and Average Energy Savings** – The CMAP assumes that 20% of all commercial building space (square footage) is retro-commissioned to reduce average energy use by 15% by 2020, and 40% of commercial space achieves a 15% reduction by 2035.

- **Percentage of Commercial Area that Can be Retro-commissioned** – The calculation assumes that all commercial building space in the City of San Diego is eligible to be retro-commissioned regardless of age.
- **Energy Reductions Calculation**- Energy reductions are calculated as a percentage of average commercial energy consumption per square foot. The average commercial electricity and natural gas consumption value is converted to million British thermal units (MMBTU) and combined to create a normalized energy consumption value. Reductions are calculated by taking a percentage of the normalized MMBTU value and then divided between electric and gas based on an average allocation between the two of 70% electric and 30% natural gas.

Sources

- The Cost-Effectiveness of Commercial Building Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States, available at eetd.lbl.gov/emills/pubs/pdf/cx-costs-benefits.pdf
- CEC Options for Energy Efficiency in Existing Buildings - http://www.energy.ca.gov/2005publications/CEC-400-2005-039/CEC-400-2005-039-CMF.PDF.

New Construction Efficiency (Residential and Commercial)

California has strong building energy standards, many local governments require or encourage new construction projects to exceed these standards. This measure estimates the incremental greenhouse gas reductions from exceeding statewide standards. For the residential sector, the total greenhouse gas reduction value includes both single family and multifamily dwellings. Note that this measure only estimates the incremental greenhouse gas reductions associated with requirements that are better than statewide building energy codes; energy reductions from statewide standards are described below in the Statewide Measures section.

- **Participation Rate –** CMAP calculations assume that 15% of residential and commercial projects participate through 2016 and then 100% of projects participate through 2020.
- **Average Energy Savings** – The CMAP assumes that all new residential and commercial construction reduces energy savings to a level that is equivalent to 15% better than Title 24 requirements.
- **Energy Reductions Calculation**- Energy reductions are calculated as a percentage of average energy consumption per square foot for commercial and per unit for residential. The average electricity and natural gas consumption value is converted to

million British thermal units (MMBTU) and combined to create a normalized energy consumption value. Reductions are calculated by taking a percentage of the normalized MMBTU value and then divided between electric and gas based on an average allocation between the two: 70% electric and 30% natural gas for commercial and 40% electric and 60% natural gas.

- **Energy Covered by Building Energy Standards** – Calculations assume that for commercial projects 60% of electricity and 70% of natural gas usage is subject to Title 24 requirements. For residential projects, it is assumed that 30% of electricity and 85% of natural gas is subject to Title 24 requirements.
- **Rate of New Construction** – For residential projects, it is assumed that single family homes are built at a rate of 1% of the total number of residential units in 2010, declining to 0.5% in 2020 and multifamily are built at a rate of 1% of total residential unit in 2010 and 2.2% in 2035.
- **Zero Energy Homes by 2020** – Calculations estimate emission reductions through 2020, assuming that by 2020 a zero energy home regulation will be in place and that there is not incremental emissions reduction from local policy.

Sources:

- California Energy Commission Residential Appliance Saturation Survey, available at http://www.energy.ca.gov/appliances/rass/
- California Energy Commission Commercial End Use Study California Energy Commission, available at http://www.energy.ca.gov/ceus/
- San Diego Association of Governments population and housing projections, SANDAG Data Warehouse, available at http://datawarehouse.sandag.org/

Residential Solar Water Heating Retrofit

On January 21, 2010, the CPUC approved a Decision creating the CSI-Thermal Program, which allocates significant funding to promote solar water heating (SWH) through a program of direct financial incentives to retail customers, training for installers and building inspectors, and a statewide marketing campaign. Assumptions used to estimate the emission reductions from solar water heaters are provided below.

- **Participation Rate** – The CMAP assumes that 10% of existing single-family homes install solar water heaters by 2020 and 25% by 2035.
- **Ratio of Electric and Natural Gas Water Heaters** – The CMAP estimate assumes that solar water heaters are installed in combination with both electric and natural gas water heaters. We further assume that 60% of the systems offset natural gas water heaters; 40% offset electric water heaters.

- **Energy Savings** – Based on Itron's evaluation study of CCSE solar water heating pilot program, we assume that the annual energy reduction is 117 therms for a natural gas water heater, 2,700 kWh for an electric.
- **Useful Life** – Estimates assumes a useful life of 25 years for solar water heaters.
- **Single Family Housing Only** – The estimates here only calculates the effect of solar water heaters on single-family homes.

Sources

- CSI Solar Water Heating Pilot Program Final Evaluation Report, Itron. March 2011, available at http://energycenter.org/index.php/incentive-programs/solar-water-heating/swhpp-documents/doc_download/727-swh-pilot-program-itron-final-evaluation-report.
- CPUC Decision 10-01-022 (January 21, 2010), available at http://docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/112748.htm.

Commercial Solar Water Heating

On average, commercial customers use about 30% of their natural gas energy to heat water in the San Diego region. This measure estimates the impact of installing solar water heaters.

- **Natural Gas Only** – The CMAP estimates assume that in the commercial sector, solar water heaters will offset natural gas only.
- **Percentage of Total Water Heating Energy Covered** – The CMAP assumes that 10% of all the natural gas used to heat water in 2020 and 25% in 2035.
- **Energy Reduction** – A reduction of 50% of natural gas use for both 2020 and 2035 is assumed.

Sources

- Commercial End Use Survey, California Energy Commission, 2006 (CEC-400-2006-005-1), available at http://www.energy.ca.gov/ceus/.
- CSI Solar Water Heating Pilot Program Final Evaluation Report, Itron. March 2011, available at http://energycenter.org/index.php/incentive-programs/solar-water-heating/swhpp-documents/doc_download/727-swh-pilot-program-itron-final-evaluation-report.

Clean and Efficient Distributed Generation - Photovoltaics

The California Solar Initiative provides financial incentives for electric customers to install photovoltaics system on their homes and businesses.

- **Total Installed Capacity** – The CMAP assumes that in 2020 there will be 50 MW of photovoltaic capacity on homes in the City of San Diego and 300 MW by 2035. For commercial buildings, the value is 150 MW in 2020 and 400 MW in 2035.
- **Capacity Factor** – Calculations assume a capacity factor of 20% to calculate the energy production of solar photovoltaics.
- **Useful Life** – We assume that photovoltaics have a useful life of 25 years.
- **Decline in Energy Production** – Calculations a1% per year decline in energy production due to module degradation.

Sources

- CSI Single-Installation Cost Effectiveness Tool, ES, August 2010, available at http://ethree.com/documents/CSI/CSI%20Individual%20Installation%20Tool%203_11_2011.xls
- CA solar initiative California Solar Statistics, available at http://www.californiasolarstatistics.ca.gov/.
- Galen Barbose, Naïm Darghouth, and Ryan Wiser, Tracking the Sun III: The installed cost of Photovoltaics in the US from 1998-2010, Lawrence Berkeley Laboratory, December 2010, available at http://eetd.lbl.gov/ea/emp/reports/lbnl-4121e.pdf.

Clean and Efficient Distributed Generation - Cogeneration

Cogeneration is typically more efficient than large centralized power plants because it uses waste heat for another useful purpose (e.g., heating or cooling water). Consequently, greenhouse gas emissions from cogeneration are lower per unit of energy than other types of generation using natural gas. Emissions reductions are calculated by multiplying the total amount of energy produced by cogeneration capacity by an emissions savings rate (lbs/MWh).

- **Total Installed Capacity** – The CMAP assumes that in 2020 there will be 200 MW of cogeneration capacity in the City of San Diego and 300 MW by 2035.
- **Capacity Factor** – CMAP estimates use an average capacity factor of 80% to calculate electricity production. This value represents the weighted average of capacity factors for the estimate additions by size (MW).
- **Emissions Savings Rate** – Calculations use an average emissions savings rate of 264 lbs/MWh, which is derived by taking an average emissions rate for combined cycle natural gas power plants and subtracting an average emissions rate for cogeneration.

Sources:

- E3 Modeling inputs for New CHP Built in 2008 and 2020, available at www.ethree.com/GHG/New%20CHP%20Data.032408.xls
- *Assessment of California CHP Market and Policy Options for Increased Penetration,* EPRI, Palo Alto, CA, California Energy Commission, Sacramento, CA: 2005, available at http://www.energy.ca.gov/2005publications/CEC-500-2005-173/CEC-500-2005-173.PDF
- Darrow, Ken, Bruce Hedman, Anne Hampson. 2009. *Combined Heat and Power Market Assessment.* California Energy Commission, PIER Program. CEC-500-2009-094-D, available at http://www.energy.ca.gov/2009publications/CEC-500-2009-094/CEC-500-2009-094-D.PDF
- SDG&E Cogeneration and Small Power Production Report, available at http://www2.sdge.com/srac/Jan_Jun_2011_Final.xls
- California Energy Commission Power Plant Database, available at http://energyalmanac.ca.gov/powerplants/POWER_PLANTS.XLS

Water Use Efficiency

The water conservation goal for the City of San Diego according to SB 7X is to achieve a daily per capita of 142 gallons in 2020. The City target for 2035 is to achieve 30% per capita reduction from the average baseline in 1996-2005.

- **Energy Reduction** – The energy reduction from water use reduction is calculated on the basis of the most recent energy intensity data associated with the four of the five stages of water supply to the City (CEC 2006). These stages are: water supply and conveyance, water treatment, water distribution, end-use, and wastewater treatment. Water supply and conveyance is not included as the emissions from this are also not included in the City's inventory. The remaining stages are assumed to be within the geographical jurisdiction of the region and representative of the stages that water supplied to the City must go through. Each stage uses a different intensity of energy (see below). The CMAP assumes that the City of San Diego achieves the energy reduction from these stages according to the water consumption goals set forth in SB 7X (142 gallons per capita per day) by 2020 and 30% below the average baseline 1996-2005 in 2035.
- **Water Consumption Levels** –The estimated 2008 per capita use in the City was 147 gallons. This includes residential, commercial, industrial, institutional and irrigational uses as well as system losses. The projected BAU level is 151 gallons in 2020 and 152 gallons in 2035.
- **Energy Intensity of Water** – The energy intensities for Southern California used were obtained from the latest (2006) CEC report on energy use in California, except for

End-Use energy intensity, which was obtained from an end-use case study on San Diego (2004). The following factors were used:

	Kwh/Acre-Foot
Water Treatment	9,727
Water Distribution	111
Wastewater Treatment	1,272
End Use	3,900

- **Greenhouse Gas Intensity of Electricity** – To estimate the greenhouse gas impacts of reducing water use, we assumed a greenhouse gas intensity of electricity of 600 lbs/MWh in 2020 and 500 lbs/MWh in 2035.

Sources:

- Urban Water Management Plan 2010: Table 3-10 on total water use and projections; Table 3-12 for Base Daily per Capita Water Use 10-15 Year Ranges; Table 7, end use breakdown of energy intensity of water uses. Available at: http://www.sdcwa.org/uwmp
- Ronnie Cohen, Barry Nelson, and Gary Wolff, Energy Down the Drain: The Hidden Costs of California's Water Supply. NRDC and The Pacific Institute, 2004. Available at http://www.nrdc.org/water/conservation/edrain/edrain.pdf
- California Energy Commission 2005. California's Water-Energy Relationship, California Energy Commission. CEC-700-2005-011-SF.
- Navigant Consulting, Inc. 2006. *Refining Estimates of Water□Related Energy Use in California.* California Energy Commission, PIER Industrial/Agricultural/Water End Use Energy Efficiency Program. CEC□500□2006□118.

City Facility Efficiency Retrofits

- **Energy Reduction** – The CMAP sets a target of retrofitting existing City facilities and infrastructure to achieve an overall energy savings of 20% by 2020 and 30% by 2035.
- **City Energy Data** – The City of San Diego provided electricity and natural gas consumption data for City operations.
- **Energy Reductions Calculation**- Energy reductions are calculated as a percentage of average commercial energy consumption per square foot. The average commercial electricity and natural gas consumption value is converted to million British thermal units (MMBTU) and combined to create a normalized energy consumption value. Reductions are calculated by taking a percentage of the normalized MMBTU value

and then divided between electric and gas based on an average allocation between the two of 70% electric and 30% natural gas.

TRANSPORTATION CATEGORY

On-road transportation accounts for 53% of all City GHG emissions. Eight (8) on-road transportation measures and one land use measures affecting transportation (community smart growth plans) were assessed for GHG reduction based on existing regulatory mandates. The greatest reductions arise from federal and state mandates for vehicle fuel economy, low carbon fuel and land-use changes.

Measures Contained in SB 375

The City of San Diego will benefit from local measures that are part of the Sustainable Communities Strategy (SCS) adopted according to state regulation SB 375. SB 375 requires that the region achieve a GHG reduction per capita from personal miles driven (passenger cars and light duty trucks) of 7% in 2020 and 13% in 2035 compared with the value in 2005. The measures that will be part of the SB 375 SCS Strategy have been described by SANDAG and include: voluntary measures based on incentives for telecommute, carpools, subsidies for vanpools, buspools, and safe routes to schools to encourage walking to school; bottleneck relief projects such as increase in miles of freeway lanes to reduce fuel inefficient congestion; increase in the price of parking; increase in miles of high occupancy vehicle lanes and freeway tolls; bicycle and pedestrian zone improvements; smart growth and population density improvements; and mass transit frequency increases.

Land use related to smart growth, the portion of the regional parking pricing program over which the City has jurisdiction, and bicycle improvements within the City are separated from the above SB 375 measures. This helps to differentiate the measures into those that are out of City control and those over which the city jurisdiction.

As voluntary measures for telecommute, carpools and mass transit have not been shown to be significantly successful in the past, it is assumed that only 50% of the reductions outside of City control will be achieved in each target year, 2020 and 2035.

Telecommute

This voluntary incentive based measure is included in the SB 375 reduction amount.

- **Percentage Jobs Eligible for Telecommute** -- 33% of all jobs in the county
- **Percentage of Workers with Eligible Jobs that Choose to Telecommute** -- Not all eligible workers choose to telecommute. The current level is estimated as 10% of the eligible jobs in the county.
- **Number of Days Telecommuted** -- A typical worker with a telecommutable job telecommutes twice per week. Several large software companies, such as IBM, have

employees telecommuting on average 4 days per week, resulting in greatly reduced need for office space, thus costs

Mass Transit

Mass transit is part of regional traffic demand management that is included in the SB 375 reductions

- **Percentage commuters using mass transit** - Currently about 3.7% daily of all commuters, SANDAG expects this value to double by 2050 by increasing the frequency, providing incentives, and adding some routes.

Vanpools

GHG reductions due to vanpools are included in the SB 375 reductions. Vanpools are taxpayer (through SANDAG) subsidized dedicated vans operated by private entities and used for commuting from residential areas directly to the workplace and back. There are over 700 vanpools in operation in San Diego County, most covering large commute distances, such as from Temecula to San Diego city. Similar incentive programs are to be available to encourage carpools and buspools

- **Average one-way distance:** 56 miles.
- **Current average persons per vanpool:** 8.3
- **Monthly vanpool subsidy:** $400 to providers.
- **Monthly fee:** Vanpoolers pay up to $120 in fees.

Bottleneck Relief Projects

Bottleneck relief projects include high occupancy vehicle toll lanes as well as other toll lanes, and freeway expansion for congestion relief. Both are measures included in the SB 375 reductions to achieve GHG reductions from which the City of San Diego will benefit. GHG reductions from freeway expansion comes from short-term changes to the speed profile on freeways. The addition of freeway lanes in congested areas and peak hours allows traffic flow to harmonize, and speeds to change from very low (less than 15 mph) to more fuel-efficient levels between 40 and 65 mph.

- **Congestion relief:** freeway expansion on 132 miles of congested freeway by 2030.
- **High Occupancy Vehicle lanes and Toll (HOT) lanes** : 80 miles

Source

SANDAG Regional Transportation Plan 2050, Chapter 3, Sustainable Communities Strategy, available at:
http://www.sandag.org/index.asp?projectid=349&fuseaction=projects.detail

SANDAG Board Meeting, July 9, 2010, Item 3, SB 375 Implementation, available at:
http://www.sandag.org/index.asp?committeeid=31&fuseaction=committees.detail - mSched

Other Transportation Measures

The following measures are not included with the above SB 375 reductions.

Parking fee increases

Increasing parking fees for residential and commercial uses has been shown to decrease the use of vehicles in those areas. Parking fee increases and the resulting GHG reductions were based on research-based best estimates of the number of parking spaces in the City metropolitan area over which the City has jurisdiction.

- **Average daily parking rates**: increase from $20 per day in metropolitan area in 2008 to $24 in 2020 and $30 in 2035
- **Number of parking spaces under city jurisdiction**: 80,000 in both 2020 and 2035
- **Elasticity of parking pricing with VMT**: 0.1

Source

SANDAG, Regional Transportation Plan 2050, available at:
http://www.sandag.org/index.asp?projectid=349&fuseaction=projects.detail

Preferred Parking for EVs

By encouraging EV use, the average daily commute by conventional GHG -emitting vehicles would be avoided and replaced by zero emission vehicles.

- **Preferred Parking for EVs**: 10%, 20% of all metropolitan area parking spaces in 2020, 2035 respectively
- **Miles commute avoided by conventional vehicles per day**: 25

Parking space reductions

Reducing parking spaces in metropolitan areas encourages alternative transportation, walking and biking, thus reducing VMTs.

- **Reduction in number of parking spaces**: 10% less in 2020, 20% less in 2035

- **Number of spaces under City jurisdiction**: 80,000 in in 2020 and 2035
- **Miles commute avoided by conventional vehicles per day**: 25

Convert Municipal Passenger Vehicle Fleet to EV

Converting the municipal passenger vehicle fleet gradually to EVs will reduce gasoline use, thus GHGs. The City of San Diego provided current use of gasoline consumption. It was assumed that there would be no changes in 2020 and 2035 to this gasoline demand.

- **Gasoline use**: 50% reduction in gasoline use 2020, 90% reduction in gasoline use in 2035, baseline year 2008

Source

City of San Diego for fleet gasoline consumption

Bicycle Infrastructure

SANDAG's regional bicycle strategy includes increasing the number of bicycle lanes conducive to commuter use. A portion of these lanes is within City boundaries and is thus expected to reduce miles commuted by conventional vehicles to provide GHG reductions within the City.

- **Miles of bicycle lanes**: Increase from 1.1 lane miles per square mile today in the City to 4 lane miles per square mile in 2020 and 8 lane miles per square mile in 2035.
- **Miles vehicle commute avoided**: 8 miles per day

Source

SANDAG, communication, for average bicycle commute distance in City of San Diego

Percentage Electric Vehicles

Increasing the number of electric vehicles in the personal vehicle fleet helps to reduce emissions, particularly as renewable energy supplies a larger portion of electricity. The default percentage of miles driven by electric vehicles were calculated from a California Energy Commission projection of electricity use for electric vehicles in 2010, 2020 and 2035 in the SDG&E service territory. Electricity values were converted to miles using the following assumptions.

- **Electricity Equivalent of Gasoline** – CMAP estimates used 34.7 kWh/gallon.

- **Miles per Gallon Equivalent** - Estimates assumed that electric vehicles would achieve 100-150 miles per gallon equivalent over the study period.
- **Percent driven by EV miles**: 4% of personal miles driven in 2020, 11% of personal miles driven in 2035. These are therefore the miles avoided by conventional fuel vehicles.

Source

- Kavalec, Chris and Tom Gorin, 2009. California Energy Demand 2010-2020, Adopted Forecast. California Energy Commission. CEC-200-2009-012-CMF, available at http://www.energy.ca.gov/2009publications/CEC-200-2009-012/index.html.

LAND USE

Smart Growth

Smart growth refers, among others, to land development that involves re-zoning land uses to enable more efficient urban mobility. It is assumed that all smart growth projects planned in the City's communities will be implemented by the target years. These increases reflect increases in mixed-use zones and population density increases, leading to reduced VMT.

- **Population density increase**: 12% in 2020, 27% in 2035, compared with 2008
- **Elasticity of walking due to population density increase**: 0.07
- **Elasticity of transit use due to population density increase**: 0.07

Source

Demographics and Other Data, available at:
http://www.sandag.org/index.asp?classid=26&fuseaction=home.classhomePopulation

SANDAG, Regional Transportation Plan 2050, Chapter 3, available at:
http://www.sandag.org/index.asp?projectid=349&fuseaction=projects.detail

More information about community smart growth plans are found at:
http://www.sandag.org/index.asp?projectid=296&fuseaction=projects.detail

WASTE

Divert Waste and Increase Capture Waste Gases

The IPCC Waste model was used by City staff to produce landfill methane and N20 emissions, which were converted to CO2e by multiplying by the GWPs. Waste disposed is forecast from 2011-2035 including diversion from 2022 as Miramar closes, and any additional waste is recycled, sent to Sycamore or diverted outside City of SD. Landfill gas capture data were provided by the City.

Wastewater emissions data and BAU calculations and results were provided by the City.

- **Landfill methane capture rate:** 80% capture of total estimated landfill gases in 2020 and 2035.
- **Wastewater treatment capture rate:** 98% capture of potential estimated wastewater treatment gases

STATE AND FEDERAL MEASURES

State Electric and Natural Gas Measures

Emissions reductions associated with the renewable portfolio standard is included the City of San Diego CMAP. As the percentage of renewable electricity delivered to residents and businesses increases, the greenhouse gas intensity of electricity decreases.

California Renewable Portfolio Standard

Legislation signed into law in 2011 requires California's electric utilities to provide 33% of electricity supplies from renewable sources. This requirement is known as the Renewable Portfolio Standard (RPS). Increasing the level of renewable energy supply lowers the greenhouse gas intensity of electricity (lbs/MWh). The following assumptions are used to calculate the emissions reductions expected from the Renewable Portfolio Standard.

- **RPS Targets** – It is assumed that SDG&E will reach the 33% target by 2020 and maintains that level through 2035.
- **Electricity Sales as a Baseline for RPS Calculation** – Estimates use electricity sales as the baseline to calculate the emissions impact of renewable supply in the region. The level of sales is adjusted to account for energy efficiency measures included in the City of San Diego CMAP.
- **Renewable Energy has No Emissions** – For simplicity, calculations here assume that all renewable energy supply emits no greenhouse gases.

Sources

- Renewable Portfolio Standard Bill (SBX 1 2), available at http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.pdf.

State and Federal Transportation Measures

Federal Corporate Fuel Economy Standards adopted by the federal government will improve the fuel efficiency of the fleet of cars and light-duty trucks in the City of San Diego. Furthermore, California has adopted a Low-carbon Fuel Standard that seeks to reduce the greenhouse gas intensity of transportation fuels. Both of these policies will reduce overall emissions in the City of San Diego.

CAFE standards: Passenger Vehicle and Light Duty Truck Fuel Economy

California and other states agreed to conform to the latest federal mpg standards, known as the Corporate Average Fuel Economy Standards (CAFE), announced in May 2009, in place of the state AB 1493 (2002, Pavley I), which required manufacturers to conform to stringent tailpipe emissions standards for greenhouse gases. California has thus amended AB 1493 (Pavley I) to conform to the federal CAFE standard from 2012 to 2016, on condition that it receives a waiver to set its own vehicle standards after 2016 and enforce its standards for model years 2009 to 2011. CAFE mandates the sales-weighted average fuel economy (in mpg) of the passenger cars and light-duty trucks for a manufacturer's fleet. New passenger vehicles must meet a sales weighted average of 39 mpg, light duty trucks a value of 30 mpg, resulting in an average 35.5 mpg for the fleet if it is met only by fuel economy improvements. This corresponds to a CO2e target of 250 grams/mile in 2016 from those vehicles.

- **Date Achieved** - The CMAP assumes that Pavley I or CAFE 2016 standards for new passenger vehicles are achieved by 2020
- **Improvements after 2020** – It is assumed that there will be no further fuel economy or tailpipe emission standards in 2035.

Source:

- Average Fuel Economy Standards, Passenger Cars and Light Trucks, MY 2011; Final Rule is available at http://www.nhtsa.gov/fuel-economy.

Low-Carbon Fuel Standard (LCFS)

The California LCFS (2010) requires that, starting January 1, 2011 and for each year thereafter, a regulated party must meet the average carbon intensity requirement of 10% reduction in carbon intensity per Mega joule for its transportation gasoline and diesel fuel in 2020. Electricity suppliers are considered regulated parties only if they elect to provide credit to fuel distributors. At this time, there are no monitoring reports of the status of use of electricity credits for the LCFS to indicate the magnitude of carbon intensity reduction that electric vehicles will play in 2020. Therefore, for CMAP purposes, miles driven by electric vehicles are not considered a part of this standard. CMAP also assumes no new low carbon fuel mandates in 2035. It is possible that the interaction of this standard with electric vehicles will have to be re-visited in a few years.

Source:

Information about the LCFS program is available at:
http://www.arb.ca.gov/fuels/lcfs/lcfs.htm

BUSINESS-AS-USUAL PROJECTION METHODOLOGY

On Road Transportation

The City of San Diego provided vehicle miles traveled (VMT) data for the years 1990, 2004, 2007, 2008 and 2009. Forecasts for VMT for 2010, 2020 and 2035 were made based on San Diego Association of Government (SANDAG) population growth rates for the City.

EMFAC 2007 Series 12 input files for the region were provided by SANDAG for the years 2010, 2020 and 2035. EMFAC 2007 was run in burden mode to provide CO2e for the region for the years 2020 and 2035. This was converted to a CO2e/VMT for the region, which was assumed to represent the CO2e/VMT for the City. City emissions projections were calculated with this CO2e/VMT factor and the City's forecasted VMT.

The BAU projections for on-road transportation do not include emissions reductions due to the Pavely I/CAFÉ fuel economy standards or the Low Carbon Fuel Standard, or the miles driven by electric vehicles.

Electricity

The City of San Diego provided historical electricity consumption values for 1990, 2004, and 2007-2009. To project City of San Diego values, we used California Energy Commission (CEC) forecasts for the San Diego Gas and Electric (SDG&E) service territory through 2020 (linear projections to 2035) to develop an average ratio between City of San Diego total consumption and SDG&E consumption for years 2007-2009.

This ratio value was multiplied by the CEC forecast through 2035 to get an estimate of the City of SD consumption levels. The ratio value used (42%) is roughly equivalent to the ratio of franchise fee revenue from the City of San Diego to the overall SDG&E territory for years 2006 and 2007.

To estimate emissions from electricity, projected consumption levels were multiplied by the greenhouse intensity value for electricity (lbs/MWh) used by the City of San Diego to calculate electric emissions in 2009. The value used was 720 lbs/MWh.

Natural Gas

The City of San Diego provided historical natural gas consumption values for 1990, 2004, and 2007-2009. To project City of San Diego values, we used California Energy Commission (CEC) forecasts for the San Diego Gas and Electric (SDG&E) service territory through 2020 (linear projections to 2035) to develop an average ratio between City of San Diego total consumption and SDG&E consumption for years 2007-2009.

This ratio value was multiplied by the CEC forecast through 2035 to get an estimate of the City of SD consumption levels. Note that the gas data used by the City of San Diego to calculate their inventory includes gas used for electric generation using cogeneration, therefore the ratio of City-provided consumption levels is higher than the ratio (about 75%) without natural gas for cogeneration (about 45%).

To estimate emissions from electricity projected consumption levels were multiplied by a conversion factor of 0.0053052 MMT CO2e/million therms. This is equivalent to 5.31 metric tons of CO2E per therm.

Waste

The City of San Diego provided both landfill and wastewater treatment emissions for 1990, 2004, 2007, and 2007-2009, and forecasts for 2020 and 2035. For landfill emissions, the City of San Diego used the IPCC Waste Model to calculate landfill methane and N20 emissions, which were converted to CO2e by multiplying by their global warming potentials. Changes to waste disposal inputs as well as closure of the Miramar landfill from 2022 were taken into account for forecasts for 2035. The business as usual projection for 2020 and 2035 includes the current approximately 70% of the total potential landfill gas emissions captured today.

Wastewater emissions were calculated by the City based on EPIC's 2008 GHG Inventory methodology. This used a methane or nitrous oxide emissions factor per person developed by the California Air Resources Board for the region. The emissions factor for methane was 9,855 grams per capita, for nitrous oxide 95 grams per capita. The BAU for 2020 and 2035 includes the approximately 71% of wastewater treatment emissions captured today.

Sources:

IPCC Waste Model, available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html

EPIC Greenhouse Gas Inventory, Waste, available at: http://www.sandiego.edu/epic/ghginventory/

Water

The BAU projections for the City's water use are available in the County Water Authority's Urban Water Management Plan (UWMP, 2010). The 2008 per capita value of 147 gallons was interpolated between the 2005 and 2010 actual water use data in the UWMP 2010.

The BAU per capita daily value 2020 is 151 gallons. The 2035 BAU per capita daily value is 152 gallons.

Sources:

Table 3-10, Urban Water Management Plan 2010 available at: http://www.sdcwa.org/uwmp